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ABSTRACT

The guide examines creative problem solving strategies for gifted and talented students (kindergarten through intermediate levels). The 33 strategies are arranged alphabetically by title and include the name of the developer, grade level, purpose, time allotment, strategy instructions, examples, application and/or variation, resources, and comments. Among strategies included are brain storming, developmental sequences, directed discovery learning, frame geometry, independent study processes, productive thinking, simulation games, social sciencing, and a synetics problem solving method. The guide concludes with an annotated bibliography containing 48 references listed alphabetically by author/editor. Each entry includes a summary of contents and a suggested grade level use. A briefer, unannotated list of resources is also provided. This document is part of the Iowa Area Education Agency 7 Teacher Center project. (CL)

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CREATIVE PROBLEM SOLVING AND THINKING STRATEGIES FOR THE GIFTED AND TALENTED STUDENT

WITH ANNOTATED BIBLIOGRAPHY

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CREATIVE PROBLEM SOLVING AND THINKING STRATEGIES FOR THE GIFTED AND TALENTED STUDENT WITH ANNOTATED BIBLIOGRAPHY

Louise M. Huebner

April, 1981

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INTRODUCTION

Rationale

Due to gifted and talented students abilities to absorb subject content rapidly and to develop higher level thinking skills that often surpass those of their peers, special attention must be given to planning programs for gifted and talented students. Two areas of consideration when planning gifted and talented programs are: incorporate materials from all subject areas; present subject material using teacher/learning strategies that stimulate students' higher level thinking and feeling skills. This booklet deals with the second area of concern or teacher/learning strategies - more specifically, creative problem solving strategies. The goal of this booklet is to present a variety of good, general, workable creative problem solving strategies which can be applied to most subject areas and which will develop creative thinking skills of gifted and talented students.

Why should a teacher be concerned with using creative problem solving strategies in the regular and/or gifted and talented classroom program? Students who are capable of high performance in creative or productive thinking and problem solving often are not consistently rewarded, are not ever rewarded, or are given negative reinforcement from teachers for creative behavior. These adverse reactions of teachers to creatively productive students can be partially due to a misunderstanding or lack of understanding of the creative thinking and problem solving processes or to unfamiliarity with a definition of the terms strategy, creativity, creative thinking, and creative problem solving. As an aid to more fully understanding creative thinking and problem solving, brief term definitions follow.

Definition of Terms

A strategy is the teaching method or technique used to stimulate designated pupil thinking processes. It is a mode of teaching and includes the subject content and objectives for a particular lesson activity.

Creativity is a difficult term to define. Dorothy Sisk (Shallcross, 1977) feels creativity can be the product created or the process one goes through to create it, be judged by the innate personality of the person, or be determined by the environment. Perhaps it is a blend of all these factors.

Creative thinking deals with pupil behavior or the processes the student will use to implement a given strategy. Creative, or productive, thinking involves the following processes:

1. fluency -- student produces many responses to a given situation, emphasis on quantity, not quality.

2. flexibility -- student's thinking is directed into a variety of categories or responses, changes avenue of thought.
3. originality -- student expresses clever, unusual, uncommon responses, many prove to be useful.
4. elaboration -- student builds on a basic idea to make it more unique or complete.
5. evaluation -- student weighs ideas in terms of desirability.

Although the feeling processes of complexity, risk taking, imagination, and curiosity are hard to separate from the thinking processes, this booklet's strategies do not deal with the affective processes specifically.

Creative problem solving is a process, or a system, for approaching a problem in an imaginative way that results in effective action (Noller, 1977). It requires a wide range of conceptual, creative, and logical thinking abilities that are easily developed with the gifted and talented student.

Classroom Use of the Booklet

Since a variety of problem solving strategies are available for developing creative thinking skills, the ones found in this booklet were chosen because they were general enough to be adapted to most subject areas, could be changed or expanded to meet student and classroom needs, and were designed for Kindergarten through Intermediate grade levels. The strategies are meant to be duplicated and shared with other educators and are not limited to gifted and talented students only but can often be incorporated into the regular classroom program.

When teaching creative problem solving and thinking skills, the teacher would be wise to study problem solving and higher level thinking processes and models for a deeper understanding of these skills before applying the strategies to curricular material. When planning curriculum, the teacher must consider the content being taught; the cognitive process used by the learner; the learner's interests, age, stage of intellectual development, past experiences, and skill development; skills needed to use the strategies; and a means to evaluate the learner's progress.

If a teacher incorporates the strategies into a classroom curriculum that is exciting and planned to stimulate higher level thinking, the student will benefit by acquiring independence in learning, a sense of individual accomplishment, and the ability to organize and use thinking, reasoning, and creativity skills.

In the article "Teacher Behaviors that Enhance Creativity" (G/C/T--January/February, 1981, p. 47), Diane Akers summarizes six techniques that a teacher can use to develop creative thinking in students. These techniques are:

1. Eliminate judgemental responses -- avoid responding to students' answers with either right or wrong, good or bad, etc.
2. Probing -- ask students to clarify or comment on statements made.
3. Attribution -- credit students with their ideas; identify the source.
4. Modeling -- provide examples of the kinds of questions or ideas wanted to encourage new student behavior.
5. Reflect or rephrase -- reward, rethink, react to the students' comments.
6. Teacher silence -- wait three to five seconds after a student's comment before commenting or calling on another student.

These ideas from Ms. Aker's article hopefully will stimulate a teacher's curiosity and interest to further develop his/her own understanding of and ability to use personally or in the classroom creative thinking and problem solving skills. The effort made and the results obtained can be rewarding.

Booklet Organization

The strategies are presented alphabetically by name.

The annotated bibliography contains materials located in the Cedar Falls - Waterloo, Iowa area. The materials were mainly found at:

1. University of Northern Iowa
   Curriculum Laboratory, Education Center
   Cedar Falls, Iowa 50613
   (UNI-C)
2. University of Northern Iowa
   Main Library
   Cedar Falls, Iowa 50613
   (UNI-L)
3. University of Northern Iowa
   Malcolm Price Laboratory School
   Cedar Falls, Iowa 50613
   (UNI-LS)
4. Area Education Agency 7
   3712 Cedar Heights Drive
   Cedar Falls, Iowa 50613
   (AEA-7)

5. Teacher Center
Nellie Garvey School
2201 E. Mitchell Avenue
Waterloo, Iowa 50702
(TC)

Resources on creative problem solving and thinking strategies for the gifted and talented student are quite limited in the city libraries and bookstores.

In the Annotated Bibliography section references are listed alphabetically by author/editor. Each reference includes a location code (see the addresses). If unmarked, the reference is in a personal library or in a catalog. Each bibliographical entry has a summary of the publication's contents and a suggested grade level use.

Grade Level Code:

K = Kindergarten
P = Primary
I = Intermediate
J = Junior High
S = Senior High
T = Teacher*

* It is implied that all publications are teacher references. "T" is only incidated if the reference is solely for teachers and none of the material can be used directly with or by the student.

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During the process of planning, compiling data, and writing Creative Problem Solving and Thinking Strategies for the Gifted and Talented with Annotated Bibliography, several people generously gave of their time and provided invaluable information and advice. To these people I am forever grateful.

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Louise M. Huebner, Compiler

CREATIVE PROBLEM SOLVING AND THINKING STRATEGIES

STRATEGY 1: Artful Thinking

Developer: Nancy Naumann

Grade Level: K-6 Time Allotment: Variable

Purpose: To promote students to think about art and to introduce students to inductive thinking through art.

Strategy Instructions:

1. Have a readily available supply of art books containing paintings by the masters for resource use.
2. Divide the class into varying ability level groups.
3. Have each group list the important features of the pictures of one master and/or classify them into student labeled categories.
4. Have the students identify some of the details of the pictures in each category - put into subcategories.
5. Question the students about how the artist might have produced a certain style, why he chose to use a certain form or colors - questions will emerge from the subcategory discoveries of the students.
6. Ask the students to research the answers to their questions (limit number to be answered) and report their findings to the class - allow a variety of research and report techniques.
7. Expand the project by permitting the students to be creative artists either reproducing the artist's technique themselves or being original artists.
8. Display the pictures with verbal explanations by the artists.
9. Allow critiquing of each others art work, writing about each other's pictures, categorizing of students art work, or that step which the students themselves create to culminate the project.

Examples:

1. The reading corner has books of paintings of the great masters.
2. The class is divided into six varying ability groups.
3. One group chooses the paintings of Pablo Picasso, uses the pictures' dominant features to group the art, and labels each stack. (ex. Lonely Colors - one color; Jigsaw Puzzles - weird shapes; Garage Sale - collection of things).

4. The larger categories are subdivided (ex. color into pink and blue; shapes into people, landscapes, everyday objects, and monsters).

5. From the color category emerges two very different artistic styles. Question: How did it happen that Picasso used these completely different styles?

6. Book research is begun with each of the six children reading and reporting on one picture. The results are reported in a short text.

7. The students try being Picassos using the knowledge they had gained about his artistic styles.

8. The pictures are displayed and explained by the artists.

9. The students write about each others artistic endeavors.

Application and/or Variation:

This procedure could be used with a variety of art forms (sculpture, pottery, watercolors). Other subject areas could be expanded to include the procedure (studying the Revolutionary War - try to determine the popular styles of that period).

Reference:

Naumann, Nancy. "Artful Thinking", Learning: the Magazine for Creative Teaching, Vol. 8, No. 6. Palo Alto, Ca.: Education Today Company, Inc., February 1980, pp. 30 and cont. on 114-116.

Comments:

It is important to note that the "Artful Thinking" procedure is not to be structured but guided by the teacher. Many avenues can be discovered and used by the students with varying ways to conclude the group's project. Allow for much flexible, creative thought.

STRATEGY 2: Barter

Developer: Swyer and Elligett

Grade Level: K-6 Time Allotment: 40 - 60 minutes

Purpose: To stimulate high level thinking skills through play and games - a natural extension of life.

To teach social skills of cooperation and competition.

Strategy Instructions:

Game phases: (1) Choice, (2) Relating, (3) Bartering, (4) Summary. Use groups of 10-15 children.

Example:

For use with the primary level.

Materials: pencils, crayons, laminated magazine pictures, candy, small toys, small "Me" box for each child, name tag for each child.

A Store Boss is chosen. He asks "Who would like to go to the store?" All answer, "We do!". The boss opens the store door (imaginary).

1. Choice - each child chooses some displayed items (pencils, crayons, toys) to put in his "Me" box.
2. Relating - Store Boss asks each child to show his/her name tag and indicate choices. Each item marked with code (2 toys = 2 t).
3. Bartering - Store Boss announces they may trade with one another for 5 minutes if they desire.
4. Summary - each child shares what he/she did (traded Mary one pencil for two pictures, left with. . .).

May replay the Barter step several times if desired.

Reference:

1. Sisk, Dorothy, "Simulation: Learning by Doing", The Gifted Child Quarterly, Vol. XIX, No. 2. Hot Springs, Arkansas: The National Association for Gifted Children, Summer 1975, pp. 175-180.

2. Hyman, Ronald, "Simulation Games", Ways of Teaching. Lippincott Company, 1974.

Applications and/or Variations:

Rules and activities may be changed as the pupils and teachers decide. Can use a spinner to determine number of items purchased. Can work together as a small group (2-3) to secure items. With upper grades, may want to provide debriefing periods between steps for the children to discuss what they have done and also do only one phase daily.

Comments:

STRATEGY 3: Brainstorming

Developer: Alex F. Osborn

Grade Level: K-6 Time Allotment: Variable

Purpose: To present a technique for increasing ideation using divergent thinking.

Strategy Instructions:

Geared for operation within a group of 6-8 people.
Basic ground rules for brainstorming:

1. No Criticism - avoid verbal and non-verbal criticism.
2. Freewheeling - accept all ideas or thoughts presented.
3. Quantity - state ideas briefly, aim for as many as possible (10% of the ideas might be workable solutions).
4. Hitchhiking - allow one person's ideas to spark thought within another, share the excitement and fun.

Method for brainstorming:

1. Form a group and determine the objective of the session.
2. Choose a leader who is responsible for all adhering to the rules: watch for criticism and elaboration of ideas, encourage responses, provide a new reference frame for thinking if needed, and relay the need for brainstorming the chosen topic.
3. Have the leader state the four basic rules, set a time limit, and ask someone to record or tally the number of responses.
4. Allow the leader to begin the brainstorming session by encouraging the group to think of as many possible ideas or thoughts relating to the session objective.
5. Cease to brainstorm when the predetermined time limit is ended.
6. Take time to examine what occurred during the session with the individual roles and the group role. This is applicable to improving subsequent sessions.

Example:

You are stuck with the problem of entertaining a group of children for one hour at a birthday party. All you have is a pile of belts. What can you do?

Applications and/or Variations:

Brainstorming can be used with groups or in a solo situation. It works well with young children and is a good way to begin teaching the Creative Problem Solving Process (brainstorming a component of CPSP).

With young children it's important to write down their responses as opposed to tallying them - reinforces "no criticism" rule, enhances their self-concept, assures they have been heard, and lessens repeats.

Resource:

Shallcross, Doris J. Teaching Creative Behavior. Englewood Cliffs, N.J.: Prentice Hall, Inc., 1981, pp. 80-87.

Comments:

STRATEGY 4: Computer Minicourse

Developer: Walter X. Zukas, L.H. Berka, and Judith L. Martin

Grade Level: 2-6 Time Allotment: 9 (50 minute) class periods

Purpose: To capitalize upon the innate curiosity of students in games and codes.

Strategy Instructions:

Lesson objectives are:

1. To explain that the computer is a machine and that to get something out of a computer, one must put something into it.
2. To develop the concept of output and how output becomes input. (Field trip between lessons 2 and 3).
3. To make the student stop, think, and then proceed to put the elements of an everyday event in logical order (introduction to computer flow charting).
4. To give the students an opportunity to write a computer program to reproduce their names. (Two class periods).
5. To introduce the use of a computer terminal in class (includes execution of computer program from #4).
6. To introduce a simple computer language (BASIC), including the writing of simple mathematical programs.
7. Completion of program writing from the previous lesson and execution of these programs on the terminal (1½ class periods).
8. Summary, discussion, and test.

Examples:

1. The computer card code (it's columns, characters, rows, punched holes) is explained with each student having a "decoding" card and reference card with the student's name. Each student is asked to decode a secret message found on a third card. Computer vocabulary is introduced.
2. Each student is given a "secret" number card and must decode it. The students then place themselves in numerical order. (Time = 15 minutes, Computer Time = 1.5 sec.) Discuss input and output time. (Field trip to computer center).

3. Practice with flowcharting. A class activity might be: Write down the precise directions one might give Martians on how to brush their teeth.

4. Students are given a 72 x 10 grid of zeros on which they print their names in block letters going through zero and putting an X on each zero where the lines touch. They then flow chart their step by step progression.

5. The instructor translates this verbatem into a workable computer language. The programs are run and the student traces his mistakes, steps 6 and 7. More abstract lessons are presented and run.

Applications and/or Variations:

Lessons 1 and 2 are applicable to second and third graders. Grades 4 and 5 can only understand the simplest mathematical computer programs. The course is limited only to the students' abilities to understand mathematical concepts.

References:

Zukas, Walter X., L.H. Berka, and Judith L. Martin. "Teaching Fourth and Fifth Graders About Computers", Arithmetic Teacher, Vol. 28, No. 2. Reston, Virginia: National Council of Teachers of Mathematics, October 1980, pp. 25-27.

Comments:

A more detailed description, including lesson-by-lesson details, can be obtained from the authors. Teachers can obtain background information for teaching the course by taking the most elementary computer course offered at a high school or college.

STRATEGY 5: Concept Creation

Developer: Donald F. Nasca

Grade Level: K-6 Time Allotment: Variable

Purpose: To allow a student to better be able to organize and classify experiences in his world.

Strategy Instructions:

1. Classification - Arranging heterogeneous objects or ideas into discrete groups.

2. Definition - Creating a definition that establishes the basis for determining concept membership. Must be sufficiently precise to discriminate between exemplars and non-exemplars presented in heterogeneous groupings.

3. Naming - Creating a name for the concept.

4. Evaluation - Inviting classmates to use the definition in making decisions about the exclusion of exemplars.

Examples:

1. For concrete operational students: Give a box of assorted objects (crayons, foods, or pictures). Sort the objects into at least three groups. The description must be accurate enough for someone else to take away anyone of the objects from the box and place it in one of the three groups.

2. For formal operational students: May include groups of items with either sensory or abstract qualities (ideas, senses, emotions, themes, religions, etc.). Examine the people in your environment. Divide them into at least three groups. Prepare a written description that presents the distinguishing characteristics of each group. Does your description provide enough information that classmates could make decisions about placement of additional individuals into one of your groups? Can you find another way to group these people - a way no one else might think about?

Applications and/or Variations:

Suggestions may come from students' questions, interests, and experiences or by observing the environment.

References:

Nasca, Donald F. "Creative Concepts for the Gifted", G/C/T. Mobile Alabama: G/C/T. Publishing Company, November/December, 1980, pp. 47-48.

Comments:

This process cannot be used to teach concepts. It requires only a heterogeneous group of stimuli with sufficient commonality to provide a basis for grouping together.

STRATEGY 6: Creative Problem Solving

Developer: Alex Osborn, plus others

Grade Level: K-6 Time Allotment: Variable

Purpose: To use a process or system for approaching a problem in an imaginative way that results in effective action.

Strategy Instructions:

The five steps of the process include:

1. Fact finding - taking the puzzle or problem situation attempt to find out what is already known through questioning.

2. Problem finding - try to state the possible problem(s) in many different ways.

3. Idea finding - having selected a particular problem or subproblem (in the form: In what ways might we...?), try to generate as many ideas as possible to solve the problem.

4. Solution finding - look at strengths and weaknesses of the ideas and evaluate these against developed specific criteria in order to find the best possibilities.

5. Acceptance finding - develop a plan of action to use the promising ideas and combinations to solve the problem.

Examples:

The classroom is dull, drab, depressing. The "mess" is what can be done?

1. Fact finding - where's the room, what's in the room, how is the furniture arranged, etc.

2. Problem finding - In what ways might we: rearrange the furniture; bring in things to spruce up the room; get student and parent help?

3. Idea finding - Select a problem from step 2 and list as many ideas as you can to answer the question, stretch the mind.

4. Solution finding - List and number the criteria you might use to evaluate the ideas, such as materials readily available, cost effect, time required to accomplish.

Use a chart with Ideas as the rows and Criteria across the top.

IDEAS	CRITERIA						TOTAL
	1	2	3	4	5	etc.	
1	3	1	3	3	1	2	13
2	2	2	3	2	3	3	15
3	1	2	1	1	1	2	8

Evaluate ideas against the criteria and rank them 3 = good, 2 = fair, 1 = poor. Total the values for each idea. Examine the ideas for positive ideas, combining or eliminating ideas, changing ideas.

5. Acceptance finding - select the most promising idea or combination of ideas. Develop a plan of action for the ideas.

Applications and/or Variations:

Can be used in any subject area as long as a "mess" can be described.

References:

Treffinger, Donald J. Encouraging Creative Learning for the Gifted and Talented: A Handbook of Methods and Techniques. Ventura, Ca.: Ventura County Superintendent of Schools, May 1980, pp. 69-73.

Comments:

Feldhusen and Moore's "Simplified Creative Problem Solving Model" is also found in this booklet and applicable to the younger child or child learning to use C.P.S.

STRATEGY 7: Creative Solving Approach (to perceptive music listening)

Developer: Saul Feinberg

Grade Level: K-6 Time Allotment: Variable

Purpose: To present an approach to aesthetic listening that not only enables the student to learn about music, but also encourages him to respond intellectually and affectively to the creative process that produced it.

Strategy Instructions:

The creative approach to perceptive listening involves setting up problem solving situations in which the listener can function as both a thinker (problem-solver) and a learner (a gainer of knowledge).

Stages:

1. Preparational stage - problem is perceived, identified, and prepared for some kind of solution; a gap in information must be sensed by the individual.

2. Exploratory-transformative stage - possible answers explored and gradually transformed into a solution; the longer the search, the more creative and rich the solution.

3. Synthetic stage - solution evaluated and internalized for future learning; ultimate result further growth for the individual.

Examples: (for an entire listening course)

1. Preparational phase presents a basis or foundation of listening tasks which can build on one another:

- Give full attention to the music being heard.
- Focus on the various elements of the music.
- Be open to new listening experiences.
- Postpone judgement of the music until it has fully been experienced.
- Listen to the music many times.

2. Exploratory-transformative phase provides a creative thinking time that encourages the listener to become involved with the music elements and processes of complete pieces of music. The listener shares some of the creative problems the composer faced when writing the work and also experiences the work as an integrated whole.

3. Synthetic phase encourages students to make aesthetic judgements when verbalizing about creative processes in music, when offering criticisms about specific works and performance interpretations, when distinguishing banal works from creative, and when formulating original listening guides and analyses of works of music.

Applications and/or Variations:

The sequence can be used to individualize lessons, to unify several different lessons, or to organize a series of interrelated lessons into "listening episodes". Can be used to structure an entire listening course.

References:

Feinberg, Saul, "Creative Problem Solving and the Music Listening Experience", The Journal of Creative Behavior, Vol. II, No. 3. Buffalo, N.Y.: The Creative Foundation, Inc., 1977, pp. 158-164.

Comments:

Guilford's Model of the Structure-of-Intellect provides a basis for this strategy. The author states fluency, flexibility, and elaboration are the "divergent thinking" processes used when being a creative, perceptive music listener. When relating to music, these examples are applicable:

1. Fluency - how many ways (quantity) a particular music idea is used in a music piece (how could main motif be used in Schubert's Symphony No. 5 in B flat).

2. Flexibility - involves tasks that ask the listener to indicate different ways in which music ideas are changed and combined in a piece of music, many logical solutions to a problem (after listening to a composition, make up a series of questions that relate to what was heard).

3. Elaboration - generating a step-by-step procedure to solve the problem, tasks in which the listener indicates procedures needed to carry out various ideas through music (listen to an assigned music piece up to a certain point and then describe how you would bring the piece to an end).

STRATEGY 8: Developmental Student Sequence

Developer: Leonard Davidman

Grade Level: 1-6 Time Allotment: Variable

Purpose: To produce an integrated, sequential group of lessons that move toward a general goal and to develop the student's ability and productivity to imagine, to solve problems, and to be creative.

Strategy Instructions:

PHASE I: Develop Behavioral Objectives which are step-by-step lessons that present skills and knowledge necessary for using steps #2 and #3.

PHASE II: Develop Guided Discovery lessons where students generate and analyze data to make predictable discoveries on their own.

PHASE III: Develop the Expressive Encounter which challenges the child to use the results of a guided discovery lesson in an unexpected, original manner.

Examples:

Name: Pentaminoes

Phase I: Behavioral Objectives

Lesson #1 - At the completion of this lesson, students will be able to:

1. orally explain the concept of one square inch;
2. use rulers, pencils, paper, scissors, etc. to neatly and accurately construct several one-inch squares.

Lesson #2 -- etc.

Phase II: Guided Discovery

Each student or group of students will be given 150 one-inch squares, a roll of gummed tape, and the following instructions: "Using your squares and tape, try to construct as many different pentaminoes as possible. Try to discover how many different pentaminoes there are in the set of unique pentaminoes."

Phase III: Expressive Encounters

1. After figuring out a way to make more durable pentaminoes, create a game, competative or non-competative, making use of one or more sets of unique pentaminoes.
2. (Present a choice of encounters).
3. Etc.

Applications and/or Variations:

More than one lesson or step can be used within a phase. Phase III can be voluntary rather than required.

References:

Davidman, Leonard. "On Educating the Imagination: A Modist Proposal," Phi Delta Kappan, Vol. 62, No. 1. Bloomington, Indiana: Phi Delta Kappa, Inc., Sept. 1980, pp. 24-26.

Comments:

Phases I and II have right answers. Phase III has numerous answers. This sequence provides the child a basis in skills and confidence for using his imagination. The encounters can be minimal, middle range, or open ended. The sequence necessitates creative, pre-teaching lesson plans by the teacher rather than clarified goals after the presentation of materials.

STRATEGY 9: Directed Discovery Learning

Developer: Dr. Harold Finkelstein

Grade Level: K-6 Time Allotment: 20 - 60 minutes

Purpose: To teach math from the simplest to most complex levels by use of Discovery Learning through a rapid pace inquiry method.

Strategy Instructions:

PHASE I: Gain student attention: recognize students who want to answer only if their hands are raised. If answers are called out ignore the student.

PHASE II: Verbally, with the chalkboard, use of a pictoral diagram, etc. present the starting problem which in turn leads into more complex problems and thinking processes.

PHASE III: Catch student interest for the problem solving: present a rapid succession of problems, call on students randomly. Draw out students with examples and participation. Thru this step, a process for working the problem is discovered.

PHASE IV: Present material at the level of the students (or a level easier) and gradually increase the level of complexity and difficulty.

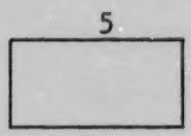
PHASE V: Work with one process until the students feel comfortable with it.

PHASE VI: Do not define, talk about, or explain the concept itself until the process is understood.

Note: Before the strategy is utilized it is assumed the teacher has determined thru lesson plans the concept or objective to be developed for the specific class period. All problems lead up to and incorporate the development of this concept or objective.

Examples:

Lesson objective: Discover how to find the perimeter of a rectangle.

Teacher places on the board 

P =

Questions:

1. Raise your hand if you can solve the problem. Student with raised hand recognized. (answers 16)
2. How many agree?
3. How long is this side? (points to shorter side, answer 3)
4. Across the bottom? (answer 5)
5. How do we get 16? (answer, you add 5 and 3 and 3 and 5)
6. What's five and three? (answer 8)
7. What's 3 and 5? Let's have some hands! (answer 8)
8. What's 8 and 8? Everybody! (answer 16)

At this point the concept of perimeter could be incorporated by asking:

1. What does this answer tell us? (answer, how far around the rectangle is)
2. What is another name for that? (answer, perimeter)
3. How could you tell a friend to find the perimeter?
4. How could you find the perimeter of another rectangle?

(Understanding of rectangle a prerequisite for this problem.)

Applications and/or Variations:

Students can invent their own symbols and terms for ease in learning (ex. Instead of 1/3 use 1f3). Process

can be used with written assignments and tests plus incorporated in other subject areas.

References:

McNett, Ian. "It Worked for Socrates," American Education, Vol. 15, No. 9. Washington, D.C.: Office of Education/H.E.W., November, 1979, pp. 33-38.

Comments:

Positive attitude of the teacher plus constant encouragement for each student allows for maximum participation. Nonparticipants can be encouraged by asking them to pick someone with a hand up, calling out names of students with hands up, or counting to see the number of raised hands and then encouraging a greater number. Discovery learning is a group activity but allows for much individual participation. The teacher must be alert to individual needs and abilities and include all in the rapid inquiry action. Directed Discovery Learning is based on three principles:

1. Students are recognized only if they participate in an orderly manner. (hand raised quietly)

2. Negative competition and criticism among students is discouraged. The process is emphasized. (crossed arms may mean disagreement - nonverbal)

3. The teacher must prepare thoroughly for the daily lesson taking into consideration individual student needs and competencies. (no student response, teacher to blame)

STRATEGY 10: Encounter Lessons

Developer: Rogers (1969)

Grade Level: K-6 Time Allotment: 20 - 30 minutes

Purpose: To encourage divergent thinking by allowing each pupil to think who he is, who he could be, and who he is in relation to others.

Strategy Instructions:

WHAT IS IT?: Encounter lessons are experiences dealing with "encounters" with ideas, materials, people, and activities. They are "involving" activities in which the students actually see, hear, taste,touch, smell, and react to central stimuli. They are open-ended activities allowing for individual uniqueness.

TEACHER ROLE: As a teacher/participant, a facilitator for building on others ideas to foster individual creativity and develop simultaneously a feeling of a single working unit.

STUDENT ROLE: Aided by the teacher, the student will---

1. Think about who he is and what he can and ought to do;
2. Feel valuable and worthwhile;
3. See learning as relevant to his individual needs;
4. Develop and maintain a learning atmosphere that reflects psychological safety and freedom.

Example:

Lesson: Body Painting
Objective: To develop body awareness

Stand comfortably with your weight evenly distributed or stretch out within an arm's length of one another on the floor (on one's back) and close your eyes. Now very slowly and methodically paint your entire body from head to toe.

Think of how you look. What sort of "paint" were you using? What parts of your body reacted quite strongly to the brush stroke? Are you working in long strokes or quick strokes? Where did you begin, at your head or foot? How do you feel now that you are through? Choose a partner to share your experience.

Applications and/or Variations:

References:

McCumsey, Janet, Encounter Lessons for the Gifted and Talented. Area Education Agency 7, Cedar Falls, Iowa 50613.

Comments:

STRATEGY 11: Extended Think-Time

Developer: Linda B. Gambrell

Grade Level: K-6 Time Allotment: Variable

Purpose: To develop higher level thinking skills through skillful questioning.

Strategy Instructions:

1. Teacher plans when during the lesson questions and think-time should be incorporated.
2. Teacher selects several questions involving inferential and/or problem solving thinking skills to produce answers.
3. Teacher tells the students the questions will involve think-time and immediate responses are not necessary.
4. Teacher asks the question and allows for think-time after the question and after each response.
5. Teacher promotes and allows for discussion of student responses.

Examples:

A reading lesson:

1. The questions will be asked following the independent reading of the story.
2. Three questions that cannot be answered with one word or a simple phrase are developed.
3. After the students have read the story, the questions are asked one at a time allowing at least 5 seconds of think-time after the question and following student responses. All answers are accepted but open for teacher and/or student disagreement. Questions can be rewarded for greater clarification. Hand waving and quick responses are discouraged.

4. Question answer discussions present time for determining correct answers, why answers were right or wrong, other possible answers to the questions.

Applications and/or Variations:

Easily used with science and reading where higher level-thinking skills are to be developed.

References:

Gambrell, Linda B. "Extending Think Time for Better Reading Instruction," The Education Digest, Vol. XLVI, No. 6. Ann Arbor, Michigan: Prakken Publishing, Inc., Feb. 1981, pp. 33-35.

Comments:

The author feels think time allows the student private thought for comprehension and for incorporating new material into already existing knowledge.

Think time has to be 5 seconds or more to elicit higher level thinking. Changes that occur with think time are:

1. Length of student response increases.
2. Appropriate responses increase.
3. Speculative thinking increases.
4. Higher level thinking is allowed.

STRATEGY 12: Focus Unit

Developer: Joy Moss

Grade Level: 3-6 Time Allotment: Variable

Purpose: To use literature as a rich natural resource for developing language and thinking skills and for stretching the minds and imaginations of all children regardless of their intellectual capacity, experiential background, or maturational level.

Strategy Instructions:

1. Determine the primary and/or secondary goals of the unit to be presented.
2. Select a wide variety of applicable materials to be read aloud, discussed by the whole class, or used as independent reading.
3. Display the materials for easy browsing.
4. Determine a "regular story time" when a selected book can be introduced and discussed through a series of teacher-initiated questions (Note: quality questions are critical to the unit for stimulating higher levels of thinking). Goals of the questioning process are:
   a. to help children form the habit of searching for meaning;
   b. to assist children in building strategies for analyzing and synthesizing ideas.
5. Implement the unit through a series of learning experiences designed to realize the unit's primary goals.

The "regular story time" is the core experience from which all others evolve.

Examples:

1. The primary goal of the Fable Focus Unit is "to help children discover the basic characteristics of this ancient form which is such an integral part of our literary past."

2.-3. The selected materials can be collections or single editions, represent different countries, have diverse artists, or represent varying reading levels. They are displayed in the room.

4. Selected fables are introduced during the "regular story time" and questions are carefully planned to stimulate each student's thinking. The questions are related to the goal(s) of the unit.

5. The unit implementation begins with reading aloud one or more fables during story time. The teacher then initiates dialogue by inviting spontaneous comments and introducing the questions. From this core follows a variety of experiences:

a. Assorted information about the fables are put on a chart and then categorized.

b. As a pattern for the various fables developed, a definition is formed.

c. The validity of the definition is tested by reading other fables.

d. Each child selects a favorite fable character and draws it for a class book.

e. Each character is labeled with its vices and virtues (list drawn by brainstorming).

f. The book is displayed in the library.

g. Impromptu dramatizations of fables emerges.

h. Fables, proverbs, and myths with similar messages are explored.

i. A small group research project on Aesop begins.

The evolving experiences are often student stimulated with teacher guidance for direction and scope. The unit's termination is dependent upon interest and time available.

Applications and/or Variations:

The Focus Unit can include The Fable and Historical Perspective, Modern Fables, and Creating Modern Fables.

The Focus Unit can be used with all forms of literature.

Reference:

Moss, Joy. "The Fable and Critical Thinking," Language Arts, Vol. 57, No. 1. Urbana, Illinois: National Council of Teachers of English, Jan. 1980, pp. 21-29.

Comments:

The author feels this unit model is designed for all children within the classroom. The gifted are offered a variety of potentially challenging learning experiences appropriate to their individual interests and capabilities while not being isolated from their peers. The unit also develops student creative thinking skills plus encourages creative teaching.

STRATEGY 13: The Formula

Developer: Lee Knutsen

Grade Level: 2-6 Time Allotment: Variable

Purpose: To present a formula for teaching science to the gifted and talented. To present a formula that can be adopted to any science unit or situation for the gifted and talented.

Strategy Instructions:

Involves "Lesson One" which prepares students to work with the Formula and "Lesson Two" which is the Formula.

Lesson One: Brainstorming or divergently producing ideas.

1. List brainstorming rules on the board and discuss them:
   a. Criticism is not allowed.
   b. May build on ideas of others, but may not comment either positively or negatively on their ideas.
   c. Any ideas are acceptable.
2. Have the class do a brainstorming activity (10 minutes).
3. Group the class into 4 or 6 for "serious brainstorming" (10-15 minutes):
   a. Recorder writes responses, shortened.
4. Groups read ideas to the class but do not repeat those already given. Ideas are listed on the board.
5. Set up criteria for evaluating the ideas.

Teacher remains as impartial observer.

Lesson Two: The Formula where the teacher is the group facilitator and the students project directors.

1. Presenting the problem - Teacher
2. Defining - Delimiting the problem - Students
3. Basic Tools (Foundation) - Teacher
4. Collecting data - Students
5. Forming Hypothesis - Students
6. Designing Experiments - Students
   Controlling Variables
   Running Control Groups
7. Specific Job Assignments - Students
8. Presenting Results - Students
9. Drawing Conclusions - Students
10. The Zinger - Teacher

Example:

Lesson One:

1. Rules listed.
2. Example: Name everything you can think of that is soft, white, and edible.
3. Example: How would you improve a school pencil?
4. Group ideas.
5. Criteria: Does it actually solve the problem or create new ones?; Is it practical?; Are people able to handle it?; Is it beneficial?; etc.

Evaluate each idea against each criteria.

Lesson Two:

1. Problem: What are molds? Why do they grow?
2. a. Brainstorm as a class to break problem into smaller components:

   What are molds?
   Why and how do they grow?
   Do they grow?
   How do you identify a mold?

   b. Brainstorm in small groups to determine what needs to be known to solve any part of

the problem. If many ideas occur, pieces of the problem may be split between groups. Input is listed under appropriate headings on the board, the class decides which items to eliminate and which items are necessary to solve the problem.

3. Tools: Vocabulary/illustrations. Vocabulary is listed on the board that will help solve the problem. Students define and illustrate the words.

4. & 5. During class discussion students are asked what they know about molds from experience, reading, or guessing - listed on board without comment. Group discards irrelevant input and selects information to use when designing experiments. (Forming a hypothesis.)

6. Students decide most basic piece of data for the experiment. (You can always tell mold because it's fuzzy.) Brainstorm in groups to produce the experiment. (Grow mold on bread and see what kills the mold.):

a. Variables - discuss with the group and have them brainstorm for control of the variables (ex: how much water, how much light, how old bread).

b. Control Groups - control experiment differs from the main in only one variable (ex: one dampened bread slice in indirect light, the second dampened bread slice in direct light). Students pair the groups and only one variable can differ.

7. Who cares for what?

8. How to present results to class - daily charts, anecdotal records, etc.

9. List all conclusions - decide which conclusive or not. Revise or eliminate conclusions and set another set of experiments or controls.

10. Zinger - evaluation of students through a teacher-designed problem suggested by information made available through specific experiments and discussions generated by the students.(ex: How can you kill mold?). Student works individually on problem at home and produces an experiment. A time limit is given and credit based on individual's efforts. Students share and discuss with the class.

Applications and/or Variations:

Adaptable to any science unit and can be used with either heterogeneous or homogeneous groups. If heterogeneous use with the entire class once and then let the gifted become independent.

References:

Knutsen, Lee. "Teaching Fifty Gifted Science Units in Two Easy Steps," Science and Children, Vol. 16, No. 6. Washington, D.C.: National Science Teachers Associations, March 1979, pp. 51-53.

Comments:

Teacher allows for plenty of small group brainstorming and is nonjudgemental.

STRATEGY 14: Frame Geometry

Developer: Marion Walter

Grade Level: K-6 Time Allotment: Variable

Purpose: To present informal geometry by posing and solving problems, clarifying problems, and discovering different ways to solve problems.

Strategy Instructions:

1. Students close their eyes, see their favorite picture, open eyes, and draw it.
2. Discussions of the pictures and picture frames follow..
3. The teacher presents a problem involving frames.
4. Materials for solving the problem in a variety of ways are available.
5. Emphasis is placed on a variety of ways to discover the "right" answer - not the answer itself.

Examples:

1. Students usually put their pictures in a picture frame or rectangle which leads to step #2.
2. Discuss how picture frames are made, materials used, how they look.
3. Problem: Assume the frame maker has as many sticks of lengths 3 cm, 5 cm, and 8 cm, as we want. How many different shapes of frames can be made? Student questions develop at this point. (Is a 3 cm x 5 cm frame the same as a 5 cm x 3 cm?)
4. Materials depend upon the students' abilities. They may include:
   - -precut sticks or sticks for students to measure and cut (wooden sticks v plastic joints, straws & pipecleaner joints, paper clip chains).

-grid paper on which to draw homes.

-pencil and paper to write out dimensions, plan a table.

-various stick lengths other then those stated in the problem for discovery of any 3 different lengths work.

5. A variety of problem-solving approaches can be shared with other students, listed on the chalkboard, displayed on the bulletin board.

Applications and/or Variations:

Consider a 3 x 5 frame different from a 5 x 3. Limit the conditions to 2 sticks per side. State the conditions as 2 or more sticks per side. Discuss frames that have different sizes but the same shape. Present a long stick of a given length and ask how many ways it can be cut into 4 pieces to make frames of different shapes and sizes. Explore triangular, trapezoidal, or polygonal frames.

References:

Walter, Marion. "Frame Geometry: An Example in Posing and Solving Problems," Arithmetic Teacher, Vol. 28, No. 2. Reston, Virginia: National Council of Teachers of Mathematics, October 1980, pp. 16-18.

Comments:

The teacher needs to be cognizant of others mathematical concepts or functions that can develop from this approach and be explored. Subject areas such as art and language arts can be incorporated with the geometry unit.

STRATEGY 15: Future Projection Sociodrama

Developer: E. Paul Torrance following the problem solving model described by Torrance and Myers (1970)

Grade Level: K-6 (designed for use with the gifted disadvantaged)

Time Allotment: 15 - 30 minutes daily, days involved variable

Purpose: To combine creative problem solving with creative expressive activities in the education of (disadvantaged) gifted students. To have a class or group explore a future situation of a type that the members are likely to be involved in combining sociodrama and the problem solving model of Torrance and Myers (1970).

Strategy Instructions:

"Future problems" for study should come from concerns of group members and course content and should be of genuine concern to most group members. The strategy steps are proceeded with a warm-up whereas many specifics and particulars of the situation (future problem) as possible are emphasized. In other words the future should be made as real as possible.

1. Define the problem: discuss the important facts, identify difficulties and conflicts.

2. Establish a situation (conflict): identify the main or central conflict of the problem, may discover more than one conflict to be studied one at a time.

3. Casting characters (protagonists): roles should be played by those who identify the greatest with them, a group may play one role.

4. Briefing and warming-up actors and audience: actors are given a few minutes to plan the setting and agree upon a direction; meanwhile the leader warms up the audience to their roles; actors then establish their role identities more clearly and describe the setting.

5. Acting out the situation: may be single scene or a series of scenes from a few seconds to 15 minutes using a variety of techniques.

6. Cutting the action: director stops the action when the actors stray from their roles, the episode concludes, or when a chance is seen to stimulate a deeper level of creativity.

7. Discussing and analyzing the situation and the behavior: actors and audience discuss their feelings, new insights, new hypotheses, possible solutions, etc.

8. Making plans for further testing of ideas for new behavior: identification of alternative solutions produced by actors and audience, evaluation of alternatives, decision concerning further testing.

Examples:

Future problems might be:

Automobiles barred from large cities.
Legalization of marijuana.
Proposed legislation to guarantee an annual wage of $7,000 to all families.
Establishment of an international police force.

The younger child can use roles and problems involving family members and community people such as the fireman, policeman, nurse, doctor.

Applications and/or Variations:

1. Go beyond the thought level and see new aspects of the future problem through elaboration with drawings and other visual representations, creative movement, song, music. (Ref. 3).

2. Use creative reading to study the future. Read materials with imagination and elaborate them with drawing, creative movement, and other means. Suggest speculation about the future. Resource: (1) In With Skies and Wings (Clymer and Wulfing; 1969, p. 147) using Claudia Lewis' "Three Skies." (2) The Best New Thing (1971) by Isaac Asimov. (3) Skills handbook for To Turn a Stone (Clymer and Wardeberg, 1971, p. 152).

3. Write stories in which future problems are examined.

References:

1. Clymer, T. and Wardeberg, H. Skills Handbook: To Turn a Stone. Lexington, Mass.: Ginn and Company, 1971.

2. Clymer, T. and Wulfing, G. With Skies and Wings. Lexington, Mass.: Ginn and Company, 1969.

3. Cunnington, B. F. and Torrance, E. P. Trailblazer to the Skies: The Robert Goddard Story. Lexington, Mass.: Ginn and Company, 1965.

4. Torrance, E. Paul. "Four Promising Practices for Teaching Gifted Disadvantaged Students," Promising Practices: Teaching the Disadvantaged Gifted. Ventura County Superintendent of Schools, March, 1975, pp. 14-17.

Comments:

The effectiveness of this procedure in sociodrama depends upon the significance and importance of the situtation for the group and the extent to which they are able to project themselves into the future.

STRATEGY 16: Independent Study Process (ISP)

Developer: Edith J. S. Doherty and Louise Evans

Grade Level: 3-6 Time Allotment: 10 - 15 week term

Purpose: To provide independent study experiences that produce students who are self-directed investigators with good research skills and appropriate methods of inquiry.

Strategy Instructions:

PHASE I: Teacher Led (first five weeks)
Main objective is to introduce the depth and breadth of the academic area through a combination of general exploratory and group training exercises as defined by Renzulli (1977).

PHASE II: Independent Study (IS) (second five weeks)
The students develop the research and investigative skills that characterize the self-directed learner (Doherty & Evans; 1980)
Nine steps are involved:

1. Select the topic.
2. Plan a schedule.
3. Write the first objectives or questions.
4. Locate the resources.
5. Take notes and use professional methods of inquiry.
6. Write the final objectives (apply new third knowledge in developing new ideas).
7. Ask student final objectives at the student-teacher conference.
8. Make the product - student exhibits and tests some of his new ideas.
9. Evaluate the product.

PHASE III: The Seminar (for students not involved in the IS for more than 5 weeks).

Examples:

Teacher led phase: each student selects one area of study from three units such as Chronobiology, Greek Mythology, and "the future."

Independent study phase: student chooses area of interest from the teacher led units, locates and uses data, produces new ideas, and develops a product to be examined by experts.

1. Student chooses "inflation" to research after learning from an economics unit.
2. Student incorporates trip to Florida into the I.S. schedule.
3. Student uses his interests to write questions to direct his research and guide his choice of resources.
4. Student uses books, magazines, films, filmstrips, tapes, records, realia , and people for resources guided by step 3.
5. Student chooses or combines the different styles of inquiry presented by the teacher for collecting data.
6. Student writes questions for the student-teacher conference which show how much she has learned and explains some of the new ideas learned.
7. Student spends 15-20 minutes talking with the teacher about ideas, conclusions, and speculations. Teacher assists student in solidifying his conclusions and proposing new ideas.
8. Student product is creative outgrowth of the research - experiment, model, play, game, filmstrip, lesson for another class, invention, or debate - not regurgitation of notes.
9. Student may keep a journal or log of the I.S. and then discuss the product with classmates, experts, etc. to discover strengths and weaknesses of the research.

Applications and/or Variations:

References:

1. Doherty, Edith J. S. and Louise Evans. "Help! Need Direction in Independent Study?," G/C/T, No. 16. Mobile, Alabama: G/C/T Publishing Co., January/February 1981, pp. 43-46.

2. Doherty, Edith J. S. and Louise C. Evans. Self-Starter Kit for Independent Study: A Practical Guide to the Independent Study Process for the Gifted Student. Austin, Texas: Special Education Associates, 1980.

3. Renzulli, Joseph S. The Enrichment Trend Model: A Guide for Developing Defensible Programs for the Gifted and Talented. Mansfield, Ct: Creative Learning Press, 1977.

Comments:

The authors state the key to success is not the process itself but teacher awareness of student readiness. At first the teacher must be fairly pedantic with the researchers but then be keenly aware of when to allow greater freedom for each student as he becomes more experienced with process.

STRATEGY 17: Interscholastic Future-Oriented Problem Solving

Developer: E. Paul Torrance following the problem solving model described by Torrance and Myers (1970)

Grade Level: K-6 (designed for use with gifted disadvantaged)

Time Allotment: 30 minute periods; days involved variable

Purpose: To promote interscholastic brainstorming and problem solving competition in order to provide creatively gifted students, especially disadvantaged ones, a better chance to enter the reward structure of schools.

Strategy Instructions:

A prerequisite for team members is an understanding of and practice with brainstorming and the creative problem solving process. Both strategies are found in this booklet.

1. Teams of 2 to 4 children are formed for competition.
2. A recorder for each group is chosen: an adult may record responses; a recorder may be chosen from the team; or each team member may record their own responses and then share these. Note: Essential to communicate the team members' ideas to avoid duplication and to be "sparked" by one anothers' ideas.
3. Competing teams are involved in all phases of the creative problem-solving process from identifying problems and challenges to preparing to put the ideas into use.
4. In the C.P.S.P. where production of alternatives is involved performance is evaluated by:
   a. number of appropriate responses reported
   b. originality of the responses
5. In the C.P.S.P. where evaluation of ideas and decisions are involved, performances are judged on:
   a. basis of adequacy of criteria
   b. skill in applying the criteria to make a decision

6. Competitive practice sessions are allowed before competition begins.

7. Time allotment for competitions may vary with age, grade level, and problem complexity.

8. Teams are given the same problem and equal time to produce results.

9. Criteria by which the results are judged will vary with the competitive situation and may be developed by the students, teachers, community, people, judges, etc.

10. Judges can be same age or older students, teachers, parents, lay people, etc. It is essential the judges understand the C.P.S.P.

11. Competition rules, the judging process, and rewards should be determined prior to the competitive event.

Example:

This problem allows the student to forecast and plan the future.

1. Problem: "Worsening traffic conditions in cities, plus increasing scarcity of building space may lead to increased use of high rise buildings for apartment and commercial use. People could live, work, and shop in the same buildings and obtain community services (doctors, barbershops, theaters, etc.) at the same place."

2. What problems might be caused by such a trend? List as many as you can.

3. What is the real or most important problem? State for creative attack.

4. Now brainstorm possible solutions to this problem following the basic rules of brainstorming.

5. Formulate criteria for evaluating your alternatives and apply these criteria to 10 of your most promising solutions. Select the best one for implementation.

6. How can motivation to implement your best solution be aroused?

7. Formulate criteria for evaluating your proposed solutions and apply these to 10 of your best alternatives and select the most promising ones.

8. Work out a plan for implementing your best solution and motivate others to cooperate.

Applications and/or Variations:

1. This strategy may be used only with the "brainstorming" step of the C.P.S.P. - more applicable to the younger child or when the child is learning the C.P.S.P.

2. This strategy is applicable to everyday problems as well as those of the future.

3. Competition may begin within the classroom and expand to grade levels, within a school or among schools on the neighborhood, district, county, and/or state levels.

Reference:

Torrance, E. Paul. "Four Promising Practices for Teaching Gifted Disadvantaged Students," Promising Practices: Teaching the Disadvantaged Gifted. Ventura County Superintendent of Schools, March 1975, pp. 7-10, 17-18.

Comments:

The creative teacher can adapt this strategy to the disadvantaged gifted or gifted, varying age and grade levels, varying curriculum content, and large or small groups - be expansive and don't limit its application.

STRATEGY 18: Iowa Problem Solving Project

Developer: Joan Duea, George Immerzell, Earl Ockenga, John Tarr, Jack Wilkinson

Grade Level: Modules 1-4 for grades 5-6
Modules 5-8 for grades 7-8

Time Allotment: 1 unit takes 10 class periods

Purpose: To improve mathematical problem solving abilities of students.

Strategy Instructions:

A module includes a skills book, a problem deck, and a final test. The classroom set also includes a teacher's guide.

1. Teacher's Guide contains:
   - -instructional module experiences
   - -objectives for and overview of the skills book lessons
   - -use of skills book and problem deck
   - -sample skills book
   - -problem deck answer key and record sheet
   - -module test, form A and B
   - -use of the test
2. Skills Book use:
   - -children work in pairs with one calculator
   - -children practice skill training techniques needed to work the problem deck
   - -children review use of the problem deck
3. Problem Deck: (100 problems)
   - -student pair chooses any problem card (easiest to hardest are blue, yellow, white, red, green)
   - -problem is read
   - -answers are kept on own paper

-answer key is posted in the room

-hints are found on back of the card

-record on record sheet attempted and correctly done problems

4. Test:

-administered after a minimum of three days with the problem deck

-Form A to one partner, Form B to second partner

-use 1 calculator per student pair

-answers are written on student's paper

Examples:

1. Skills Book I

I have $61 and plan to save $7 a week. How can I use my calculator to find how many weeks it will take before I have saved enough to buy one of these $173 T.V. sets?
(TURN PAGE UPSIDE DOWN) for help.
One helpful hint might be:

a. Get to know the problem. (How many dollars will he have in 1 week? 2 weeks?)

2. Problem Deck, Book I

(Similar to Example #1) Problem on front of the deck card with hints on the back.

3. Test Question, Book I

(7) Joy weighs 34 kg. Jim weighs 55 kg. How much heavier is Jim than Joy? Will your answer be more than 55 kg. or less than 55 kg.?

Applications and/or Variations:

All modules usable in basic math programs. Gifted students may use in 3rd or 4th grades.

References:

Earl Ockenga, Manager. Iowa Problem Solving Project, Price Laboratory School, Cedar Falls, Iowa 50613.

Comments:

Need one hand-held calculator for every 2 students. The project includes 8 instructional problem solving units.

The eight instructional modules are:

Problem Solving Using the Calculator--Book 1
Problem Solving Using Calculator Codes--Book 1
Problem Solving Using Guesses
Problem Solving Using Tables
Problem Solving Using the Calculator--Book 2
Problem Solving Using Calculator Codes--Book 2
Problem Solving Using Resources
Problem Solving Using Special Computations

The first four listed are especially well suited to grades 5-6 and the other four are for grades 7-8. All modules are usable in a basic mathematics program in high school.

While they are being developed, each module may be purchased from the Iowa Problem Solving Project in classroom sets at cost--$20.00 per set. A classroom set of a module includes 15 student booklets, the teacher's guide, and a 100-card problem deck. This accommodates a class of 30 students since two students share a booklet. A classroom set of all eight modules costs $160.00.

Ordered separately, student booklets are $1.00 each, teacher's guides are $1.50 each and problem decks are $7.00 each.

All the materials assume that hand-held calculators are available to the students--one calculator for every two students. Either the school or the students themselves provide the calculators.

For further information or to order modules write:

Earl Ockenga, Manager
Iowa Problem Solving Project
Price Laboratory School
Cedar Falls, Iowa 50613

STRATEGY 19: Mathematical Game Contest

Developer: Douglas E. Cruikshank and John A. Martin, Jr.

Grade Level: K-6 Time Allotment: Variable

Purpose: To develop problem solving, strategy, and communication skills by creating an original game.

Strategy Instructions:

A. Prior to announcing the contest the 6 components of games are discussed. (Kohl, 1974) - Use several days.

1. Theme - Milieu in which the game set.
2. Playing board.
3. Pieces - movable markers or characters used to play the game.
4. Decision Devices - spinners, dice, cards used to regulate a game.
5. Goals - what it means to win or terminate a game.
6. Teaching the game - instructions (author added).
7. Topic - what the game purports to teach.

B. Game theme and game contest rules are announced.

C. Follow thru procedures:

1. Teacher answers student questions.
2. Teacher provides class time, materials when possible, encouragement but not specific instructions.
3. The students "field test" the games to improve quality and clarity.

D. Games are judged according to contest rules and teacher-made trophies presented.

Examples:

A. 1. Themes:

Dinosaurs and swamps for subtraction.
Muppet characters for metric game.
Bottle for chess game.

2. Playing board (decorated according to theme):

Race or chase (start & finish).
Strategy (variety of forms).
Morris (squares & intersections of special lines).
Mancola (boards with cups or containers that hold seeds, etc.).
Chess & checkers (board partitioned into 64 squares, 8 x 8).

3. Playing pieces:

Buttons, beans, chips, cubes.

4. Decision devices:

Die may contain simple subtraction problems.
Deck of cards may have geometric shapes.

5. Goals:

Collect the most chips, cookies.
Eliminate competitive players.
Get dinosaurs through the swamp.

6. Teaching the game:

Need clear, concise instructions.

7. Topic:

If mathematical game contest then focus on addition, multiplication, geometric shapes and so on.

B. Theme - Addition Game

Rules can include:

1. Game limit to be judged.
2. Topic for game.
3. Inclusion of instructions or rules.
4. Deadline for submitting games.
5. When winner announced.
6. Who owns the game.
7. Judging based on ---

Applications and/or Variations:

Easily adaptable to other areas of the curriculum.

References:

Criukshank, Douglas E. and John A. Martin, Jr. Arithmetic Teacher, Vol. 28, No. 5. Reston, Virginia: Natl. Council of Teachers of Mathematics, January 1981, pp. 42-45.

Comments:

STRATEGY 20: A Model for Teaching

Developer: Catherine Yeotis and Alice Hosticka

Grade Level: K-6 (also middle school) Time Allotment: Variable

Purpose: To teach and develop problem solving skills in middle school mathematics and science curriculums.

Strategy Instructions:

The format for teaching problem solving skills includes three phases of instruction which will help to reinforce the steps in information processing needed to solve problems successfully. These steps are:

1. Identification of available information pertaining to the problem.
2. Classification of information into relevant and non-relevant categories for solving the problem.
3. Listing information assumed necessary to reach a solution to the problem.
4. Determining what information is available and what information still needs to be obtained.
5. Determining how the needed information may be obtained.
6. Obtaining the needed information.
7. Using all the relevant information to solve the problem.
8. Checking the solutions validity.

First the instructor must:

1. Investigate the student group to be involved.
2. Investigate good motivator problems for the group.
3. Investigate the skills needed to solve the problem.
4. Investigate how to evaluate and encourage student progress.

Second the instructor moves into the three phases of instruction:

PHASE I, Cue Attendance:

Students attend to all the details potentially useful in resolving a problem; students observe specific situations over and over until they can obtain a specified number of details; (steps 1-4 in information processing) students learn to systematically identify, categorize, and interrelate variables.

PHASE II, Verbalizing or Thinking Aloud:

Students are asked to verbalize each step they perform and every question they ask themselves in working towards a solution; students follow a reasoning process.

PHASE III, Developing a Diagram of the Steps of the Solution:

Students diagram the steps they go through.

Examples:

Problem: $\frac{3}{2} + \frac{7}{9} = \square$

PHASE I: Student recalls:

1. What 3/2 is.
2. What 7/9 is.
3. What the + symbol means.
4. What the = symbol means.
5. That the result is the answer to the problem.

PHASE II: Student begins to say:

1. OK, now let's see, to solve this problem, all I need to do is put 3/2 together with 7/9 and see what I got.

2. 3/2 is greater than 1 by 1/2 and 7/9 is just a little less than one. So if I put them together I'll get something between 2 and 2 1/2. Process continues until a solution is reached.

PHASE III:

The student diagrams the process done in PHASE II. (form of flow-charting or algorithm).

Applications and/or Variations:

Although designed for the formal operational thinking processes of the middle school child, this process is applicable with concrete thinkers also who can use concrete material or imagine the concrete. A simple problem such as 2 apples and 4 apples equals what (2 + 4 = ☐) can be applied to this model.

References:

Yeotis, Catherine, and Alice Hosticka, "Promoting the Transition to Formal Thought Through the Development of Problem Solving Skills in Middle School Mathematics and Science Curriculum," School Science and Mathematics, Vol. 80, No. 7. Kalamazoo, Michigan: School Science and Mathematics Associations, Inc., Nov. 1980, pp. 557-565.

Comments:

The author stresses the need for the instructor to evaluate the student, the skills needed, and the method of evaluation to determine a proper learning situation for the problem solving. Also the learner's ability to recall relevant processes that have been previously learned must be considered.

STRATEGY 21: Modification of the Place Value Game*

Developer: Janine S. Stone

Grade Level: 4-6 and gifted Time Allotment: Variable

Purpose: To provide various strategies for greater understanding of place value.

Strategy Instructions:

Student materials - paper and pencil

Teacher materials - 14 (5 x 7) cards inscribed as follows:

10 digit cards (1 digit per card)

2 operation cards (1 with ADD on it, 1 with SUBTRACT on it)

2 win cards (1 with SMALLEST NUMBER WINS on it, 1 with LARGEST NUMBER WINS on it)

Problem A:

1. Student draws a two-by-three grid for writing in two three-digit numbers.
2. Leader places on chalkboard ledge 6 randomly selected digit cards, 1 operation card, and 1 win card.
3. The students arrange the selected digits, one in each box, to find the best solution.
4. The students discover various problems and solutions are possible.
5. The students discover equal solutions are possible with different problems.

Problem B:

1. Student draws a two-by-three grid.
2. The leader shuffles the digit cards and randomly selects 6 which are held up one at a time.

3. The student puts one digit in each grid space. The digit cannot be changed once placed.

4. The leader holds up add or subtract and the student performs the operation.

5. The leader holds up either largest number wins or smallest number wins.

6. If the students feel they have a winning number they hold up their hand. The leader records the numbers on the board until a winner is found.

7. The winner then becomes the new leader.

Examples:

Problem A:

1.

2. Cards are 7, 6, 2, 4, 0, 3
ADD AND LARGEST NUMBER WINS

3.

7	4	2
6	3	0

6	2	0
3	4	7

4.
$$\begin{array}{r} 742 \\ +630 \\ \hline 1372 \end{array} \qquad \begin{array}{r} 620 \\ +347 \\ \hline 967 \end{array}$$

5.
$$\begin{array}{r} 742 \\ +630 \\ \hline 1372 \end{array} \qquad \begin{array}{r} 630 \\ +742 \\ \hline 1372 \end{array}$$

Applications and/or Variations:

1. Variation to example for Problem A:

a. Change operation card to SUBTRACT. For a solution can form abc where a b c d e f.
fed

b. Use same digits and add for smallest number. Have to form ace where a b c d e f.
bdf

c. Use same digits and subtract for smallest number.

2. Adapt to division, multiplication, fractions, percents, integers, or various digit numbers.

References:

Stone, Janine S. "Place Value and Probability (with Promptings from Pascal)," Arithmetic Teacher, Vol. 27, No. 7. Reston, Virginia: National Council of Teachers of Mathematics, March 1980, pp. 47-49.

*Found on p. 64 of Mathematics, Modern Concepts and Skills by Dilley and Rucher; Raytheon Education Co.; MA, 1968.

Comments:

The author uses Pascal's triangle to simplify the computations of any probabilities involved with the game.

STRATEGY 22:

Developer: Joseph Payne

Grade Level: K-6 Time Allotment: Variable

Purpose: To encourage gifted and talented math students to think and reason when doing a task.

Strategy Instructions:

Guidelines for encouraging thinking and reasoning with talented math students.

1. Encourage generalization and abstraction.
2. Encourage students to explain the reasons for what they do.
3. Monitor the development of basic concepts and computation skills. Balance the logical and reasoning parts of math.
4. Encourage creative extensions of content.

Examples:

1. Problem: The town clock strikes only on the hour and the number of strikes tells the hour. How many times does the clock strike in a day? Can solve by ordinary addition. Encourage the talented student to make higher-level generalizations. Questions: Can you find a shorter way to do this? Can you use what you know now to add all the counting numbers from 1 to 100?
2. Encourage not just "the one goes on top" (the steps) but why.
3. Talented students appear to understand the concept and computation but often need assistance in producing an answer with ease by the use of basic skills. (Example: Subtraction facts done backwards producing slow responses. Demonstrate 13 - 6 can be stated 6 and what is 13 - logical transition to addition.)

Talented students need to show enough paper work presented in an orderly fashion so it can be easily understood by the teacher even if thinking and reasoning can produce verbal results. (Example: Student excellent in logic and reasoning but refuses to do skill work to compute algebraic manipulations. Consequently student fails science and engineering courses because he refused to develop fundamental skills.)

4. After presenting "mind benders", have students create their own. Allow students to develop their own straw models for plan figures.

Applications and/or Variations:

This process should be used in tracking all facets of mathematics.

Reference:

Payne, Joseph. "The Mathematics Curriculum for Talented Students," Arithmetic Teacher, Vol. 28, No. 6. Reston, Virginia: National Council of Teachers of Mathematics, February 1981, pp. 18-21.

Comments:

This process is expected to develop higher cognitive thinking and higher order reasoning skills and to supplement the basic math curriculum.

STRATEGY 23: The Paper Bag Guessing Game

Developer: Molly Watt

Grade Level: K-2 Time Allotment: 15-20 minutes

Purpose: To provide students a game that uses the powers of logic, reason, intuition, and understanding as an alternative to the traditional Show n' Tell.

Strategy Instructions:

Simple extension of Twenty Questions.

1. One secret item is brought in by the child (owned, borrowed found). It must fit into a paper bag.
2. The child chooses a "counter-downer" who sits beside the secret-owner and keeps track of questions asked and questions left.
3. Twenty questions (yes or no answers) can be asked by the class. Reviews or hints can be given.

Instruction provided by the game.

1. What is a question?
2. What makes a good question? (Try to make a question eliminate more than one possibility - Is it a toy? as opposed to Is it a laser-gun?)

Allow students to assess and correct each others questions (Is it small and is it little - are they the same?).

Examples:

Self-explanatory.

Applications and/or Variations:

Use as a guessing procedure for other subject areas - secret word from spelling, secret rule from English lesson, secret country from geography. The more complex the secret the greater the need for introductory hints.

Reference:

Watt, Molly. "A Questioning Skill Game," Learning: The Magazine for Creative Teachers, Vol. 8, No. 8. Palo Alto, California: Education Today Company, April 1980, pp. 20-22.

Comments:

The teacher gains the opportunity to observe the classroom process and individual students plus is allowed time to develop listening, questioning, and summarization skills.

STRATEGY 24: The Productive Thinking Program

Developer: Covington, Crutchfield, Davies, Olton

Grade Level: Upper Elementary Time Allotment: Entire semester (longer or shorter)

Purpose: To develop the student's potential for effective thinking and problem solving through learning, practicing, and applying basic thinking skills.

Strategy Instructions:

Materials: 15 Basic Lesson Problem Set books (introduce and explain the various thinking skills and provide practice in problem solving situations).

Teacher's Guide (directions for administering the Program, suggestions for increasing its effectiveness, background information about the materials, class discussion materials, class exercise and follow-up materials).

Reply Notebook (for recording answers).

Chart (demonstrates 16 thinking skills used in the basic lessons).

I. Basic Lesson

A. My story:

1. Student reads through a story designed to teach a thinking skill. The story contains a problem which the student attempts to solve.

2. The story may require the student to state the problem in his own words, formulate questions, analyze information, generate new ideas, test hypotheses, evaluate courses of action.

3. Informative feedback enables the student to judge his progress.

4. Clues are presented to aid in discovering the solution.

5. Strategies of thinking are taught through "Thinking Guides" found in the story.

6. The stories are self-administering - individually paced.

7. Answers are recorded in the Reply Notebook.

B. The Problem Sets:

1. Each story is followed by the problem set designed to extend and strengthen the thinking skill learned in the lesson.

2. The problem set allows for application of the thinking skill.

3. The student is self-paced and records answers in the Reply Notebook.

II. Class Discussion

A. Questions are presented to reinforce skills learned in the lesson.

B. Questions are used as a follow-up of the problem set.

III. Class Exercise and/or Follow-up Practice

A. The class exercise may follow step IIA.

B. The follow-up practice may follow step IIB.

General format:
1. Basic lesson
2. Basic lesson discussion
3. Problem set
4. Problem set discussion

Examples:

1. The Story - Uncle John aides Jim and Lila who live in Elmtown to think for themselves, explore ideas, and develop a sense of personal worth. How does Jim overcome boredom or Lila learn to enjoy school? - examples of questions asked to stimulate thinking. A map making contest allows Jim and Lila to explore ideas and gain confidence in themselves.

2. The Problem Set

The Blind Man and the Elephant asks the student to guess the identity of an unknown object by the sense of touch. The student thinks of various ideas, expresses the ideas openly (all ideas accepted), and discovers thinking can be enjoyable.

3. Class Discussion

Story - "Jim feels he is often stuck when trying to think so he gives up. Does this happen to you?"

Problem Set - Discuss how one man is not always "right" but each can be partially correct.

4. Class Exercise and/or Follow-up

a. Design a new T.V. program that would help all ages learn to think. What might go into the program?

b. Students are blindfolded and all feel the same object. They must then combine their information for identification of the object.

Applications and/or Variations:

The whole class may work on the same Basic Lesson or Problem Set at the same time but are individually paced with total class discussions following completion of the task. The entire class or smaller groups may work together on the Basic Lesson or Problem Set. The teacher sets the pace as the students proceed on a planned page by page basis pausing for discussions led by the teacher.

Reference:

Covington, Crutchfield, Davies, and Olton, Productive Thinking Programs. Columbus, Ohio: Charles A. Merrill Publishing Co., 1974.

Comments:

Problem materials are not restricted to any single subject content but are diversified over a wide-range of problem types. Materials may be a new unit of the regular curriculum used to catalyze the learning process and scheduled as part of the program.

The materials may be used for specialized curriculum as enrichment for the gifted, remedial work for the slow learner, motivational material for the underachiever, or individual work.

STRATEGY 25: Pulgar

Developer: Larry Weatherford

Grade Level: K-6 Time Allotment: 30 minutes

Purpose: To involve students in a cooperative-visual experience, to break down barriers to communication among members of the group, to look at the effect of non-verbal communication on creativity.

Strategy Instructions:

Instant Pulgar Kit: 6 assorted sheets colored paper, 2 pairs scissors, 2 rolls scotch tape, 1 newspaper, 4 colored pipe cleaners, 1 colored marking pen.

1. Form groups of 5 or 6 students - sit on floor or at tables. Talk about using their imaginations and being free and creative thinkers.

2. Tell the story of the Pulgar - embellish as wish but don't describe the Pulgar.

3. Give each group a Pulgar kit. They are to construct one Pulgar but cannot use language (oral or written) to communicate with each other. They have 15 minutes to build the Pulgar.

4. After 15 minutes each group shows and explains their Pulgar and discusses what happened in terms of the process and the kinds of communication that took place.

Example:

Story of the Pulgar

In the coldest part of January, high in the mountains - just before dawn, there is nothing moving. No sound. No signs of life. The trees stand crooked, cold, and black against the frozen landscape. The snow sifts restlessly in the path of the wind's icy tentacles.

Suddenly under the snow something stirs. The snow quakes and cracks and shifts and falls away. And out from his winter sleeping place comes the Pulgar.

The Pulgar sleeps year round. Only once - in the dead of winter does he come out: to eat.

He heads for the nearest town. Down the mountain in the cold. He comes into the town - ravenous.

He eats a dog and a cat. Gobbles down a milkman and munches giant chunks of shrubbery.

He eats the wheels off a truck and crunches up a blue Volkswagon.

When he is full, eaten everything in sight, his eyelids get heavy and he needs an after-dinner nap. He slowly, sluggishly lumbers back out into the high mountains. He climbs high into the crags, digs down into the snow, and hollows out a new den. Then he falls asleep for another year.

Applications and/or Variations:

The basic format is useable with any similar story as long as the "thing" to be created is not described in the story. Teachers and/or students can make up their own stories and try them with class members or students from other grade levels or classrooms.

Children can close their eyes while the story is told. The sense of touch could be used by feeling objects that could stimulate a mental picture of the "thing." Taped sound effects could also expand the story approach.

Once the creature is made the students could be presented with challenges: How could you capture the "thing" next year?; What could you feed him so he did not eat everything in sight?; or How could you entice him to reappear in one month?.

Also, vary the "kit" materials.

Reference:

By Larry Weatherford, Cullensville, Illinois. Found at the Teacher Center, Nellie Garvey School, 2201 E. Mitchell Avenue, Waterloo, Iowa 50702.

Comments:

An excellent, basic approach just waiting for student and teacher thoughts for expansion.

STRATEGY 26: The ReTAL Model of Thinking Operations or Research Team Approach to Learning

Developer: Del Giorno

Grade Level: 2-6 Time Allotment: Variable

Purpose: To provide a model for researching a topic or problem in science that will help students develop critical and divergent thinking skills.

To provide a model using team work that will encourage students to develop sociability and communication skills.

To aid the student in arranging what is learned into sequence.

Strategy Instructions:

The Research Team consists of three persons:

1. The Researcher - defines the problem and makes the preliminary search into literature.
2. The Technician - plans the experimental design and performs the investigations.
3. The Recorder - coordinates the activities, records and interprets the findings with other team members, and disseminates the new material.

The Research Team must know how to:

1. Define the problem.
2. Limit the scope of the research.
3. Review the literature (document it if for a research paper).
4. Design and set up the experiment.
5. Record their observations.
6. Interpret results.
7. Share their findings with others and/or write a research paper.

Thinking operations of the Research Team are:

1. Deductive process (knowledge) - receives and stores information.

   a. Researcher describes topic or problem.

   b. Investigator states and defines problem.

2. Confrontation process (comprehension) - learns on own, formulates questions to be answered, poses hypotheses to be tested.

   a. Technician - determines questions to be answered.

   b. Investigator - forms hypotheses and designs experiment.

3. Inductive process (application and analysis) -

   In application:

   a. Technician runs tests.

   b. Recorder records findings.

   c. Investigator conducts experiments and records results.

   In analysis:

   a. Team discusses the literature, the tests, the results.

   b. Investigator analyzes data.

4. Evaluation process (synthesis and evaluation) -

   In synthesis:

   a. Recorder reports results.

   b. Team interprets findings.

   c. Investigator draws conclusions from results.

   In evaluation:

   a. Team decides to stop, repeat, or continue study and communicates to others.

   b. Investigator writes abstract and determines new directions for further research.

Examples:

The following ReTAL phases demonstrate how the "learner" learns.

1. Deductive process - instruction is received from the teacher, specialists, etc.

2. Confrontation process - seek knowledge from resource people, films, books, etc.

3. Inductive process - the learner's own ideas are tried out (build models, conduct test, experiments).

4. Discussion process (analysis) - examines component parts of the work.

5. Evaluation process - determines if more work required or task completed.

6. Communication - transmits new knowledge to others.

Applications and/or Variations:

The ReTAL model can be used by an individual student.

References:

Del Giorno, Bette J. "ReTAL as a Model for Developing Critical and Divergent Thinking in Gifted and Talented Students of Science," The Gifted Child Quarterly, Vol. 21, No. 7. Village, California: The National Association for Gifted Children, Spring 1977, pp. 58-69.

Comments:

The ReTAL Model parallels the intellectual processes of the learner in Bloom's (1956) taxonomy of the cognitive domain.

STRATEGY 27: The Secondary Creative Process

Developer: Doris J. Shallcross

Grade Level: K-6 Time Allotment: Variable

Purpose: To stimulate innate problem solving abilities (primary creativity).

Strategy Instructions:

Five suggested stages:

1. Orientation - defining the problem or setting the goal, deals with emotional factors.
   a. be sure it's what the group prefers to do (each member may write a paragraph on how they feel about it).
   b. use the thoughts generated to view the question in greater depth.
2. Preparation - putting before you the factual part of the problem, data gathering stage.
   a. What do you know about the problem (who, what, when, where, how)?
   b. What do you want to find out plus possible sources?
3. Ideation - applying divergent thinking to arrive at many possible tentative solutions or resolutions, asking "In what way might I .....?" or "How can I .....?" Use brainstorming at this state. Produce many ideas!
4. Evaluation - using convergent thinking discover the best solution or resolution to the problem. May use:
   a. initial screening - intuitively narrow your list to not more than 25 ideas.
   b. Set up criteria by which to judge each idea. Determine who and what will be affected.
   c. Set up a matrix listing the ideas that survived the initial screening on one side and the weighting of each criteria across the top.

Ideas / Criteria	1 X 2	2	3 X 4	4 X 1	Total Score
1.					
2.					
3.					

Numerically score the criteria: 5 = excellent, 4 = very good, 3 = good, 2 = fair, 1 = poor. Judge each idea against each criteria and total the scores. Circle the top 3-5 scores.

d. Determine the solution or resolution (idea) best applicable for implementation.

5. Implementation - drawing up a useable plan, what will work?

Examples:

Projects or problems for use when learning the process:

- Deciding upon a theme for the classroom Halloween party.
- Organizing a field trip.
- Planning a playground.
- Acquiring an aquarium.
- Landscaping the local park or playground.

Projects or problems for use with younger children:

- How to handle lost and found articles.
- How to prepare for a parents' night.
- How to care for classroom plants during the holidays.
- How to give everyone a chance to use the headsets in the learning center.

Applications and/or Variations:

The younger child needs problems he readily relates with, the older child can work with more abstract ideas.

Reference:

Shallcross, Doris J. Teaching Creative Behavior. Englewood Cliffs, New Jersey: Prentice Hall, Inc., 1981, pp. 95-112.

Comments:

The author suggests this process is not the only one but it is convenient and adaptable to many different people and situations. It can be expanded and contracted to fit the user's purposes.

The five stages are not static but can be cyclic - especially useful with more complex problems.

STRATEGY 28: Simplified Creative Problem Solving Model (SCPSM)

Developer: John F. Feldhusen and Deborah L. Moore

Grade Level: Elementary Time Allotment: 1 hour

Purpose: To develop the ability to formulate a problem and solution plus implement the solution.

Strategy Instructions:

1. Have children brainstorm in small groups of 3-5 about a general problem. Rules for brainstorming:
   a. someone records all ideas.
   b. everyone must contribute.
   c. state ideas briefly.
   d. there is no criticism, discussion, or evaluation.
   e. quantity is a goal.
   f. can build on one another's ideas.
   g. funny ideas are acceptable.
2. Group evaluates the list, discusses the problems, selects the 3 most serious or important, then the 1 most important.
3. Children brainstorm solution to the problem, following same rules as above. Solutions can be full or partial ways of solving the problem.
4. Take ideas presented in step 3 and create a synthesis for the solution. The solution might be eclectic but it should hang together.
5. Develop a plan for implementing the solution. Who, where, when, how? Then write the plan and turn it in.

Examples:

1. Brainstorm about problems on the playground.(fighting, sharing equipment).

2. Fighting.

3. Severe punishment, classroom discussion about problems, rewards for days of no fighting.

4. Design system of rewards for no fighting.

5. Chart prepared listing rewards for fight free days, urge teacher to implement.

Applications and/or Variations:

- do not limit problem area.

- break into separate shorter timed steps to allow for tight scheduling.

- use in all curricular areas.

- solve classroom problems.

- extend to individual problems encountered outside the classroom.

References:

Feldhusen, John F. and Deborah L. Moore. "A Simplified Creative Problem Solving Model," Journal for the Education of the Gifted, Vol. 3, No. 1. Publication of the Association for the Gifted, 1979, pp. 61-72.

Comments:

At first work with small groups and train. Break with traditional rules (raising hands, speaking out). The steps for "Creative Problem Solving" as presented by Treffinger are found in this booklet. C.P.S. is more applicable to the older or experienced problem solving student.

STRATEGY 29: Simulation Games

Developer:

Grade Level: K-6 Time Allotment: Variable

Purpose: To present an activity in which participants interact within an artificially produced environment which creates some aspect of social reality.

Strategy Instructions:

Simulation games involve:

1. Players - participants who assume the roles of individuals or groups who exist in the particular sound system being simulated.

2. Goals - player's the same as actors they represent; success in achieving goals depends upon how well the interaction strategy and use of resources is planned.

3. Specific Rules - govern the sequence and method of interaction; limit and guide behavior to insure players experience the same successes or failures similar to their counterparts in the real world.

In Youngers and Aceti "Simulation Games and Activities for Social Studies" simple guidelines are presented.

1. What are your objectives?

2. Design a simplified model of the "real-life" situation. Include those elements essential to meeting the objectives without having so many the simulation becomes unmanageable.

3. Place the simulation model within the context of the game.

   a. identify the players or teams.

   b. provide the players with resources.

   c. set clear objectives which are easy to evaluate during and after the game.

   d. establish the rules, in terms of game play and permissable behavior.

e. write the scenario.

Prior to the game students need an understanding of the context or setting in which the game takes place. This may take the form of a statement by the teacher, a series of teaching lessons, or individual student research projects.

Examples:

An Economics topic might be Competition. The concept of competition would need to be defined. The simulation would be:

"How Competition Works"

Materials: Several sheets of plain and colored construction paper, paste, crayons, and scissors for each child.

Procedures:

1. Divide class into groups of 3 or 4 at their desks.

2. Teacher stands with one group.

3. TEACHER: "We are going to pretend to be owners of donut shops (each group separate business firm). Now as you know, businessmen watch very carefully what other businessmen, who sell the same thing as they sell, are doing. Why do you think this is so?" DISCUSSION.

4. TEACHER: "In playing this game, you are to watch carefully what my business does and decide what you would do to stay in business."

5. Teacher starts the game by placing a sign, such as "Miss Brown's Donut Shop" on front of a desk. Students respond by thinking of company names and making signs for their groups.

   Continue with other variations such as price, quantity, quality, bargains, etc.

6. Present Questions: Is competition good?, Why?, etc.

7. Present activities: Interview a local businessman and ask how he competes with other businessmen.

Applications and/or Variations:

Can be used with young children through adults with all curricular areas.

References:

Cline, Starr, "Simulation: A Teaching Strategy for the Gifted and Talented," The Gifted Child Quarterly, Vol. 23, No. 2. Village, California: National Association for Gifted Children, Summer 1979, pp. 269-296.

Resources for simulation games:

1. Hutzman, William Ray. Educational Games and Simulations. Washington, D.C.: National Education Association, 1974.

2. _____. Games and Simulations for School Use. Board of Cooperative Educational Services, June 1974.

3. _____. Guide to Simulation/Games for Education and Training. Hecksville, New York: Research Media, 1973.

Comments:

The author states simulation is especially effective in working with gifted children. Simulation gaming can assist gifted students in developing upper levels of thinking; developing divergent thinking abilities; developing self-directed learning; gaining basic skills mastery plus reinforcing and expanding these; developing the social-affective area of adjustment; facing real problems and attempting to develop answers to these; integrating learning concepts and ideas; and encouraging risk-taking and decision-making.

STRATEGY 30: Social Sciencing

Developer: Not stated

Grade Level: K-6 Time Allotment: Variable

Purpose: To allow gifted students to assume the roles of the social scientists in the disciplines from which the social studies content is drawn.

Strategy Instructions:

The student assumes the role of the social scientist applicable to the social studies area being studied. The roles he may assume are anthropologist, economist, historian, geographer, political scientist, and sociologist.

Each social science has a unique vocabulary or jargon, sources of information, means of gathering and organizing information, and ways of treating data.

When social sciencing the student asks of the scientist:

1. How do they think?
2. What terminology do they use?
3. What methods do they employ to collect evidence?
4. What evidence do they gather?
5. How do they analyze data?

Examples:

When studying the area of Political Science the student may:

1. Define what a political scientist is.
2. Determine the skills a political scientist needs for his profession.

As the student assumes the role of the political scientist he can:

1. Collect data from newspapers and other media.

2. Write inquiry letters to government officials relating to their job responsibilities.

3. Interview community helpers.

4. Begin using elementary statistics (a variety of ways can be incorporated to learn about the role they are assuming).

The student accepts a project, task, job the social scientist might do as part of his profession.

The Political Scientist might develop an opinion poll which allows the student to investigate sampling techniques, construct questionnaires, and develop a variety of ways to report the results.

In Social Sciencing the student assumes the role of the scientist while in traditional role playing the student pretends he is the person or figure who in turn studies someone well-known in a specified area.

Applications and/or Variations:

For use with all 6 areas of social studies.

Reference:

Muir, Sharon Pray. "Social Sciencing: Social Studies for Gifted Adolescents," The Clearing House, Vol. 53, No. 7. Washington, D.C.: Heldref Publications, March 1980, pp. 323-327.

Comments:

The author cites that only a handful of programs or commercial materials utilize this approach.

A detailed bibliography of information on the disciplines as well as additional teaching materials and instructional activities is available on request from the author.

STRATEGY 31: Supervised Independent Study

Developer: Not stated

Grade Level: 2-6 Time Allotment: Variable

Purpose: To provide an individualized learning plan which allows the student to work independently, process information, and create an end product to show what has been learned. To provide the opportunity for the student to plan cooperatively with the teacher to set up objectives and evaluation procedures by which his performance can be evaluated. To allow the teacher to intervene with the student in order to keep in touch, provide directions for problem solving if needed, open up new areas for exploration and production, give encouragement and motivation, and introduce, teach, or reinforce needed skills.

Strategy Instructions:

Basic elements of the plan:

1. Student self-selection of what is to be studied.
2. Cooperative teacher-student planning of what will be studied and how it will be shown.
3. Alternative ideas for gathering and processing information.
4. Multiple resources which are readily available.
5. Teacher intervention through formal and informal student-teacher dialogues.
6. Skills integrated with the content area being studied.
7. Time specifically allowed for working and conferencing.
8. Working and storage space.
9. Sharing, feedback, and evaluation opportunities.
10. Student recognition for his "expertise" and finished product.

The student develops the plan by:

1. Selecting and delimiting subject or topic.
2. Discussing and brainstorming possible subject areas and questions to explore with the chosen subject or topic.
3. Formulating key questions or issues to pursue and answer.
4. Developing a committment to a plan or time sequence.
5. Locating and utilizing multiple resources.
6. Creating a product from the material learned.
7. Sharing with classmates the findings from the study.
8. Evaluating the process and the products from the study and how the time was spent.
9. Exploring possibilities which could extend the study into new areas of learning.

Examples (for student plan):

Steps 1, 2, and 3 The topics may be chosen from any curricular area, teacher guidance is usually needed with these steps depending upon how familiar the student(s) are with the process.

Step 4 A student-teacher contract is often used to assist the student and teacher in knowing what is to be learned and completed. These can include: student's name, date, contract title, time line, evaluation terms, day and time for conferences, teacher's name, grade level, objectives, methods of completing tasks, date for completing contrast, student and teacher signature.

Step 5 Using resources emphasize locating ideas from a variety of sources and developing thinking rather than copying skills.- people, books, films, observations, experiments. A way to organize, store, compare, sequence outline, and analyze data must be planned - write on cards and place in resource pockets or file.

Step 6 The created product must be determined: write a book, newspaper, research paper; construct a model; graphs; surveys; fact file; compare likenesses and differences; teach a mini-leasson; make a photo or

slide show; develop an original idea. More than one "product" may be used.

Step 7 The student should plan to orally present the end-product to the class and be prepared for questions/discussion that challenge the study.

Step 8 Teacher-student conferences may be scheduled or meetings where the student shows or explains what he has done. The teacher may develop "stimulating questions" for the student. Emphasis is on the student evaluating his own project. The student can keep a log of his "independent investigation project" which includes date, accomplishments, evaluation, next step (plans). This can be shared with the teacher in Step 8. He can also complete a self-evaluation form critiquing his own work.

Step 9 Seek how the project can be expanded upon or ways used to begin new areas of study with other subjects or interests.

Applications and/or Variations:

This type of study can be used across disciplines and with varied grade levels - easily adapted by the teacher to the classroom needs.

The enclosed "Independent Study Hopscotch" demonstrates how open-ended activities may be applied to any subject area being studied.

References:

Found in the "Gifted Education" file at the Teacher's Center, Nellie Garvey School, 2201 E. Mitchell Avenue, Waterloo, Iowa 50702.

Comments:

Throughout the study teacher intervention is essential and can be informal or a structured conference. This is done to:

1. Keep in touch.
2. Provide directions for problem-solving (if needed).
3. Open up new areas for exploration and production.

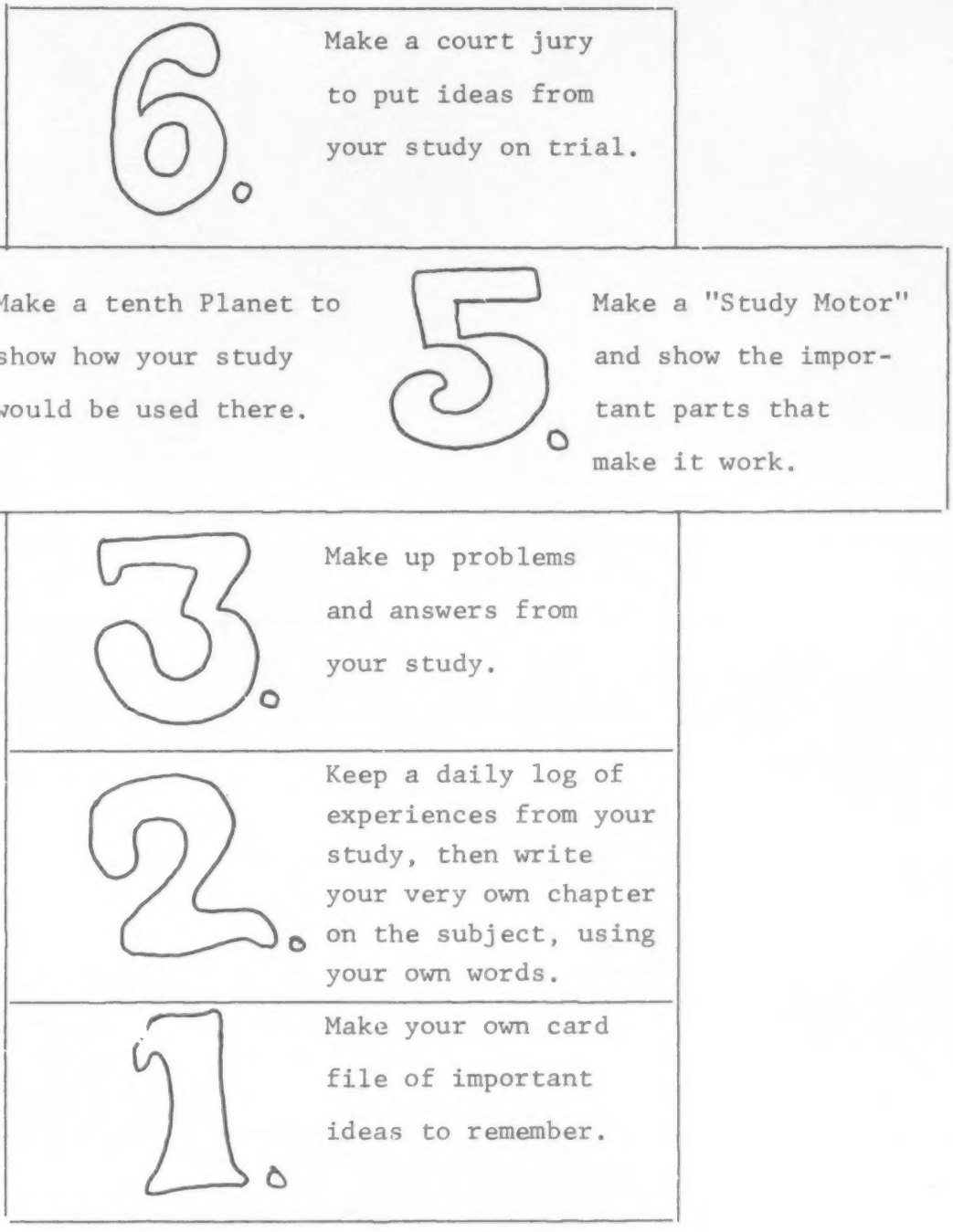
4. Give encouragement and keep motivating.

5. Introduce, teach, or reinforce a needed skill.

Questions are structured to be general and helpful: What do you need?; Are you having trouble finding or understanding the information?

Independent Study Hopscotch

These open-ended activities may be applied to any subject area being studied. The purpose of these activities is to provide new and unusual ways for children to process information. The Hopscotch may be used in numbered sequence or it may be played as a hopscotch game.


6.
Make a court jury to put ideas from your study on trial.
4.
Make a tenth Planet to show how your study would be used there.
5.
Make a "Study Motor" and show the important parts that make it work.
3.
Make up problems and answers from your study.
2.
Keep a daily log of experiences from your study, then write your very own chapter on the subject, using your own words.
1.
Make your own card file of important ideas to remember.

STRATEGY 32: Synetics Problem-Solving Method

Developer: W. J. J. Gordon

Grade Level: K-6 Time Allotment: Variable

Purpose: To deliberately stimulate creative thinking with a group problem-solving activity wherein persons are stimulated to think creatively under a loosely structured system.

Strategy Instructions:

The synetics session is an "excursion." The process begins with a problem introduced by the leader who conducts an "excursion" of the group through a series of steps which attempt to determine a solution to the problem.

Synetics Flow Chart:

1. Problems are Given (PAG) ⟶
2. Analyses and Explanation by Expert ⟶
3. Purge ⟶
4. Generation of Problems as Understood (PAU) ⟶
5. Choice of Problems as Understood (PAU) ⟶
6. Evocative Question (EQ)
   For Example (EX) ⟶
7. Choice of Example
8. Evocative Question (EQ)
   for Personal Analogy (PA) ⟶
9. Evocative Question (EQ)
   for Book Title (BT) ⟶
10. Choice of Book Title (BT) ⟶
11. Evocative Question (EQ)
    for Example (EX)
12. Choice of Example (EX)

13. Examination of Example

↓

Force Fit (FF) ⟶ Viewpoint (VP)

Examples:

The listed steps relate to the Synetic Flow Chart steps.

1. PAG - need a problem that involves the synthesis of facts and theories into a solution, not just a "fact finding" problem.

2. Expert - provides as much information as possible to aid in the solution of the problem (group member, invited member, etc.; can use visual aids, field trip, resource books, etc.).

3. Purge - participants voice immediate solutions to the problem, usually not workable. The leader or expert points out why not workable.

4. PAU - leader insures complete understanding of the problem by participants (participants may re-state or re-write the problem).

5. PAU - leader guides participants to select one of the components of the problem for intensive consideration. Consenus reached on choice of PAU.

Problem put out of mind and leader begins creative thinking aspect of the excursion by use of analogies. Four types used are:

a. personal analogy (get inside problem and view from a strange, new prospective).

b. direct analogy (view problem from biological standpoint).

c. symbolic analogy (reduce problem to 2 or 3 words, construct containing the essence of the problem).

d. fantasy analogy (suspend all natural laws and create a universe where everything is possible).

6-11. EQ - leaders ask questions which generate responses in the form of one or more of the four analogies.

a. EX - Imagine how it would feel to be a polluted river (PA).

b. EX - What would you do if you were a heart with a hole that needed repair. Imagine how you would feel.

c. EX - a heating and freezing process is "Burning Ice" (BT).

d. EX - problem is moving water uphill then create a fantasy where water can flow uphill.

In steps 6-11 the leader decides when to change or reinforce a pattern of thought and when to lead the group into steps 12 and 13. The leader and expert help to Force Fit (FF) the findings to the needs outlined in the problem. If not workable, the group returns to the analogies and tries again for a workable solution.

Viewpoint (VP) - when the group produces a useful line of thought, the leader focuses the groups attention on applying the information to the original problem. The group determines:

1. If the entire problem's been solved.

2. If a new approach must be taken.

3. If the problem should be abandoned.

Applications and/or Variations:

1. Time allowed is dependent on the skill of the group and nature of the problem - must allow enough flexible time to be effective.

2. Process may be divided into parts for individual lessons.

3. Do not have to use the entire process to be effective. Creative thinking exercises can be devised from the various stages of the process and be based on the concepts inherent in the process which are related to: problem analysis; listening; spontaneous reaction; re-statement; ordering; ranking; role-playing; and metaphorical thinking.

4. The room (intimate but uncrowded), space arrangements, and use of equipment should be considerations to ensure efficient use of working time and a relaxed environment.

References:

1. Wilson, Sandra H., Jack F. Greer, and Russell M. Johnson, "Synetics, A Creative Problem-Solving Technique for the Gifted," The Gifted Child Quarterly, Vol. 17, No. 4. Cincinnati, Ohio: National Association for Gifted Children, Winter, 1973, pp. 260-267.

2. Gordon, W. J. J., Synetics. New York: Harper and Row, 1961.

Comments:

The teacher needs to fully understand the synetics technique before using it. Reference 2 is an excellent resource.

STRATEGY 33: Thinking Skill Wrap-Up

Developer: Grover H. Baldwin

Grade Level: 3-6 Time Allotment: 7 days

Purpose: To evaluate if Social Studies students have learned to use the higher level thinking skills of application, analysis and synthesis.

Strategy Instructions:

The unit time schedule:

- 4 days plus the weekend for introductory groundwork and research
- 2 days for the debate
- 1 day for evaluation and self-evaluation

1. Determine a unit time schedule, topic, unit objectives, and tool for student expression.
2. Group the class as applicable on the basis of achievement, past performance in group settings, and creative talents shown during the school year.
3. Generate questions about the topic through brainstorming.
4. Categorize the questions for use as a guideline for research.
5. Determine how to convey information discovered through research.
6. Gather a variety of topic-related resource materials to be used in the room.
7. Guide and assist students as needed during the research phase.
8. Present research findings.
9. Determine a form of evaluation - teacher and/or student.

Examples:

1. The unit was:

   7 day length,
   a debate,
   topic - "Should Puerto Rico become a state?"
   objective (see purpose)

2. The class was divided into 4 equal groups.

3. Fifty questions were generated.

4. Question categories were political science, economics, history, and anthropology/social.

5. The students chose to allow 15 minutes to express their pro or con rationales in any manner they wished.

6. Materials came from the school librarian, regional film center, parents.

7. The teacher guided but allowed freedom for the students to develop their own rationales and evaluations.

8. The debate lasted two days with presentations, rebuttals, and summaries.

9. The debates were taped then:

   - each class member evaluated those not in his group
   - in small groups a general evaluation of the teams was produced (criteria established)
   - the better team was chosen with supportive evidence
   - each class member evaluated his own group and his own performance (criteria established)

Applications and/or Variations

For use with a range of subject areas that allow for research and evaluation.

Reference:

Baldwin, Grover H. "Thinking Skill Wrap-Up," Learning: The Magazine for Creative Teaching, Vol. 8, No. 9. Palo Alto, California: Pitman Learning, Inc., May/June 1980, pp. 30-31.

ANNOTATED BIBLIOGRAPHY

Anderson, Carolyn, and Jackie Haller. Brain Stretchers Book 1. Pacific Grove, Ca.: Midwest Publications Co., Inc., 1975.

Application: I, J, S. Location: AEA-7

This book includes 60 pages of puzzles designed to develop critical thinking skills. The reading level varies from no read to lo read as an aid to poor readers, bilinguals, lower verbals, and special eds. They can be used for individualization, independent work, motivation, and enrichment. There are three parts to the book: Patterns (series, magic squares, etc.); Logic (find the path, scrambled words, etc.); Puzzles (number mazes, hidden pictures, etc.). An answer sheet is included.

Burns, Marilyn. The Book of Think. Boston: Little, Brown, and Co., 1976.

Application: I, J, S Location: AEA-7

This is a book which presents ways in which to develop thinking skills to solve problems when you are puzzled, perplexed, or stumped, or can't get from here to there. It shows how to use your noggin when no fresh ideas occur. Different thinking ways to approach problems, exercises, and clever application problems are included in a sequential series for maximum thinking skills development - for children and adults.

The series also includes The I Hate Mathematics! book.

Callahan, Carolyn M., Editor. Journal for the Education of the Gifted. The Association for the Gifted, 1920 Association Drive, Reston, Virginia 22091.

Application: T Location: UNI-L

This journal contains information on the current happenings and current research of the gifted and talented. Its format includes a message from the TAG president and a guest editor, pertinent articles pertaining to the gifted and talented, book and/or material reviews, and a parent perspective section. It is a worthwhile journal for the consultant, teacher, parent - all involved with gifted education. Publication is quarterly.

(Although this magazine does not specifically deal with problem-solving and thinking, it does incorporate articles pertaining to these subjects.)

Carin, Arthur, and Robert B. Sund. Creative Questioning and Sensitive Listening Techniques. Columbus, Ohio: Charles E. Merril Publishing Co., 1978.

Application: K thru S Location: UNI-C

This book presents practical suggestions for teachers in selecting and using appropriate questioning and listening techniques. The emphasis is upon using questions to not only assist the student's cognitive and affective achievement, but as aids to building student self-esteem, human talents, and clarifying their values.

A chapter is included to specifically help students gain a better "impression of self" in order to build self-esteem. Other chapters deal with developing critical and creative thinking, encouraging analysis of questions, actively involving the learner in personal development, sensitive listening, and nonverbal communication. Specific questioning techniques using Bloom's Cognitive and Affective Domains are explained. Guidelines and format guides for writing and using questions creatively in all curricular areas using Bloom's domains plus techniques for applying text materials to films, filmstrips, slides, bulletin boards, etc. are included. The last chapter deals with teacher evaluation and modification of their questioning techniques.

Carin, Arthur A., and Robert B. Sund. Developing Questioning Techniques. Columbus, Ohio: Charles E. Merril, 1971.

Application: T

This book presents practical suggestions for teachers in selecting and using appropriate questioning techniques. The emphasis is upon using questions that assist the student's cognitive achievement and level of understanding plus build student self-esteem and creativity.

Chapters deal with: student's impression of self; developing creative thinking, encouraging critical analysis, and

actively involving the learner in teacher-learning for personal development; specific questioning techniques using Bloom's cognitive and affective domains; and procedures for teachers to evaluate and modify their questioning techniques to insure improvement.

Included are suggestions for discussions, audio-visual aides, evaluations, applying text materials to films, filmstrips, slides, etc., and format guides.

Curl, Shirley and Mary Giese. Creative Problem Solving. Compiled for the Teacher Center, Nellie Garvey School, 2201 E. Mitchell Avenue, Waterloo, Iowa 50702.

Application: P, I, J Location: T.C.

A brief explanation of the Creative Problem Solving Process (CPS) and Brainstorming introduce the instructional activities provided in this educational booklet. Each step of the C.P.S. process is fully elaborated with specific ways to develop the step and example exercises to do so. Great for the person who is just becoming familiar with the C.P.S. process.

Dohrman, Dr. Mary H., Educational Consultant. Challengers: Thought Provoking Activities for Gifted and Talented Students. Joint County System of Black Hawk and Buchanan Counties, Cedar Falls, Iowa 50613.

Application: K, P, I Location: T.C.

This educational booklet contains a variety of activities designed to make the student think. Included are learning activities using junk, spelling games, listening exercises for sequence, planning and building a house, estimating dimensions, and using the tape recorder. The ideas are presented to facilitate easy teacher application to the classroom - basic starters that can be expanded to other curricular areas.

Feldhussen, John F., and Donald J. Treffinger. Teaching Creative Thinking and Problem Solving. Dubuque, Iowa: Kendall/Hunt Publishing Co., 1977.

Application: K thru S Location: AEA-7

The purpose of this book is to help teachers teach children how to think and especially how to think creatively and solve problems. The book emphasizes how to apply the information and basic skills generally taught in the classroom to thinking, solving problems, or creating new ideas. The authors have combined creativity and problem solving into a single complex concept following the model proposed by Guilford and his associates.

The book also discusses the special problems of teaching creative thinking and problem solving to the economically disadvantaged; presents teaching methods and techniques adaptable to any grade level and subject area; provides specific directions on how to start a classroom project (exercises and procedures); and presents descriptions of published "teaching materials" for specific grade levels and subject areas. Ideas and materials are applicable to traditional, open, and individualized programs with a variety of students.

Fern, Lief. Teaching for Thinking. San Diego, Ca.: Kabyn Books, 1980.

Application: K thru S

This book speaks to teachers - elementary and secondary, Special and General Education, learning handicapped and gifted - about a theoretical framework upon which to base a learning-how-to-think program. It shows how to apply learning, how to think to basic skills and traditional content plus ways to make and use creative thinking materials. It also translates a language of thinking into classroom operations - defines what thinking behavior looks like. The book is less committed to teaching than to promoting learning.

Included are comments about the public's, teacher's, and student's responsibilities for creative thinking; a creative thinking process model and creative problem solving model; objectives and materials found in a creative teaching environment; thinking types to be developed; and exercises operational for the teacher and learner.

Fixx, James F. Games for the Super-Intelligent. New York: Doubleday and Co., Inc., 1972.

Application: I, J, S Location: AEA-7

The puzzles in this book were taken from the personal files of MENSA members. The author also includes techniques to solve the puzzles, comments about high I.Q. people (how they got that way and stay that way), and a test to measure your own intelligence. A follow-up book by James Fixx, More Games for the Super-Intelligent, is also available.

Foster, Kathleen M. A Guide for Teaching Thinking Skills and Creative Problem-Solving in the Gifted Classroom. San Diego, Ca.: San Diego City Schools, 1979.

Application: K thru S

The material in this guide offers teachers the opportunity to learn about creative thinking in the classroom and apply their knowledge of creative thinking skills to classroom operations. The guide treats thinking as an area of content.

The author feels the content of thinking is theoretical and the theory of creative thinking must be studied, understood, and applied in the classroom to produce creative thinking in students. Thus the guide presents several narrative statements about creative thinking in teaching and learning plus over 100 classroom-useful ideas. Creative problem solving behaviors and setting up a Creative Problem-Solving Center in the room are included with materials and resource lists for implementing the center and for teacher-student use.

Gallagher, James J. Productive Thinking of Gifted Chilren, Cooperative Research Project No. 965. Institute for Research on Exceptional Children, University of Illinois, Urbana, Illinois, 1965.

Application: T Location: UNI-L

In this research report on Productive Thinking of Gifted Children, Gallagher initially presents background material on research in the classroom and research in the cognitive processes. The project goals are then stated: to identify productive thought processes in intellectually gifted children within the context of classroom verbal activity at the junior high school level; to assess relationships between those thought processes and certain variables that may relate to their operation in the classroom. The research report is in-depth and informative as it proceeds through the research methods used, results obtained, and discussion of results. An extensive reference list concludes the report.

Gardner, Martin. Perplexing Puzzles and Tantalizing Teasers. New York: Pocket Books, Simm and Schuster, Inc., 1971.

Application: P, I, J, S. Location: AEA-7

This book has a wide-range of challenging, tricky puzzles including riddles, mazes, word games, tricky pictures, typitoons, and mysteries. Answers are given at the back of the book. They are not meant to be difficult but relaxing and stimulating.

----------. G/C/T Catalog. G/C/T Publishing Co., P.O. Box 66654, Mobile, Alabama 36660.

G/C/T publishers have a catalog that features selected items produced by nine different publishers/companies. An example of these is Wff'N Proof Learning Games (Games for Thinkers); Midwest Publications (Brain Stretchers, Basic Thinking Skills, Inductive and Deductive Thinking Skills); and Emerson Books (Puzzles for Pleasure, Mind Tickling Brain Teasers). Back issues of G/C/T magazine are also available. The companies and selections are limited but quality.

----------. The Gifted Child Quarterly. The National Association for Gifted Children, 217 Gregory Drive, Hot Springs, Arkansas 71901.

Application: T Location: UNI-L

The Gifted Child Quarterly is the only journal of this type published in the gifted area. The contents deal with a variety of subjects pertinent to the gifted: programs, creativity, classroom models, identification, resources, book reviews. The journal is an excellent source for awareness of the latest information in gifted education and with the gifted child.

(Although this journal does not specifically deal with problem solving and thinking, it does incorporate articles pertaining to these subjects.)

Gillis, Marilyn J. Thinkisthenics....Exercises for the Brain. Palm Springs, Ca.: Thinkisthenics, 1971.

Application: P, I, J, S Location: AEA-7

Thinkisthenics is designed to "turn students on" about math. The author suggests using the activities in this book for presenting new and reinforcing old math concepts, for involving students with concrete and semi-concrete teaching aids, and for keeping students interested in the story line approach. The contents vary and include quick and easy games, drills, thinking strategies, line designs, graphing, magic squares, and paper and pencil games.

Gold, Marvin J., Editor/Publisher. G/C/T (Gifted, Creative, and Talented). G/C/T Publishing Co., Box 66654, Mobile, Alabama 36606.

Application: T Location: UNI-C

The G/C/T magazine is published five times per year and contains practical suggestions and ideas for the education and rearing of gifted children and youth. The articles range from identification of the gifted and programs for them to teacher training and assistance for parents of the gifted. It is a well planned, quality magazine.

(Although this magazine does not specifically deal with problem-solving and thinking, it does incorporate articles pertaining to these subjects.)

Gordon, A. C. Solv-A-Crime. New York: Scholastic Book Services, March 1972.

Application: P, I, J, S Location: AEA-7

There are forty-seven, two page mysteries and solutions to the cases included in this book. The student assumes the role of the detective and must use the clues to solve the crimes which involve burglars, murderers, and con men. A delightful challenge for all students.

Harnadek, Anita. Basic Thinking Skills Series. Troy, Michigan: Midwest Publications Co., Inc., 1977.

Application: K thru S

The purpose of the thirteen booklets included in this series is to sharpen thinking skills using classroom discussions and/or individual student written response.

The author feels students develop different aspects of critical thinking at different times. Consequently the series materials are not presented sequentially but the teacher must determine which materials are applicable to the individual needs of the students. Each series booklet contains problems and answers for student use. Students are encouraged to suggest, discuss, and argue other possible answers. Most problem pages can be completed in 5-20 minutes.

The thirteen areas included in this series are: Analogies A-D; Antonyms and Synonyms; Antonyms, Synonyms, Similarities, and Differences; Conservation, Paths, and Miscellaneous; Following Directions A-B; Miscellaneous Including Transivity and Same Person or Not?; Patterns; Think About It; What Would You Do?; and True to Life or Fantasy?.

Materials are available in duplicator masters or booklets.

Harnadek, Anita. Critical Thinking: Book One. Troy, Michigan: Midwest Publications Co., Inc., 1976.

Application: I thru lower college Location: AEA-7

The purpose of the book is to begin to develop the skill of critical thinking by centering the materials presented in the book around class discussion. The student not only acquires critical thinking skills thru lessons on technique, exercises, and knowing the right answer but by sharing his answers with classmates by expressing his opinions, classmate rebuttal, and classroom discussions.

Included in the course materials are:

1. Introduction to Critical Thinking
2. Introduction to Logic
3. Some Basic Concepts for Critical Thinking

4. Common Errors in Reasoning
5. Propoganda Techniques
6. Advertising and Schemes
7. Examining Arguments and Values
8. Learning to be Open-Minded

Within each chapter are lesson concepts, each presented separately and followed by class exercises and classroom problems.

Harnadek, Anita. Inductive Thinking Skills. Troy, Michigan: Midwest Publications Co., Inc., 1979.

Application: K thru S

The Inductive Thinking series is available in booklets or duplicator masters. Included in the series is: Spatial Perception A-B; Inferences A-B; Open Ended Problems; Cause and Effect; Relevant Information; Figure Relations A-B; Figure Patterns; and Reasoning by Analogy.

Each booklet contains an introduction, general information section, teaching suggestions with follow-up activities, and answers. The booklets may be studied in any order desired with the exception of an "A-B" series where the "A" should be studied first.

Harnadek, Anita. Mind Benders: Deductive Thinking Skills. Troy, Michigan: Midwest Publications Co., Inc., 1978.

Application: K thru S Location: AEA-7

The student is provided with a variety of mind benders that promote organizing sets of clues - direct and indirect - and reaching logical conclusions by using pure deductive reasoning. They attract students with wide ranges of ability, motivational, and achievement levels. Seven booklets or ditto masters are available: Mind Benders Instructions, Mind Benders A1, A2 (easy); B1, B2 (medium); C1, C2 (hard). All are a happy classroom diversion.

Hunkens, Frances P. Involving Students in Questioning. Boston, Massachusetts: Allyn and Bacon, Inc., 1976.

Application: P, I, HS Location: UNI-C

This book contains a blend of educational theories with specific strategies that allow the student to develop questioning abilities and to become a more active and reflective learner. All strategies are easily adaptable to the classroom.

----------. Ideas for Aiding Thinking. From "Caring is Basic" (Workshop), Davenport Community Schools, Davenport, Iowa 52802, June 1974.

Application: P, I, J Location: T.C.

In this educational handout each area of productive thinking is listed followed by one-liner suggestions for expanding the specific thinking process.(fluent thinking, flexible thinking, original thinking, elaborative thinking, risk taking, imagination, complexity, and curiosity). Examples under fluent thinking are: think of all the things that are beautiful; what could you do with a snowball?; how many ways can you use this box?. Teachers and students can benefit from the use of this handout - excellent for learning centers, time-fillers, and as examples for those learning about the various areas of the thinking process.

Johnson, Nancy. Good Apple Workshops Present: Nancy Johnson. Printed with permission of Nancy Johnson. Good Apple consultant, "Classroom Ideas for the Gifted," March 18, 1978. Distributed by Area Education Agency 7 consultants, Cedar Falls, Iowa 50613.

Application: K, P, I Location: T.C.

This educational guide touches on characteristics of the creative and non-creative teacher, plus possible discipline for disturbing classroom behavior; Peer tutoring, the independent study approach, and contracts are shown as ways to promote independent study. Included is a suggestion for the physical arrangement of a creative room. The guide's ideas to stretch the thinking of gifted students are diverse and fun.

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Kabyn Books, P.O. Box 19663, Navajo Station, San Diego, Ca. 92119.

Application: Resource materials for K thru S

The purpose of Kabyn Books is to produce classroom-useful materials that mobilize the intellectual and creative abilities of teachers and learners. The materials are conceived and designed to serve both teachers and learners. For example: The "Ways to Have Fun with the Mind" series (includes 4 consumable books) presents specific thinking skills for the Kindergarten thru High School student; or Teaching for Thinking (teacher's book) explains creative thinking and creative problem solving in the classroom, generalizes theory to creative teaching, and makes it all practical for classroom use.

A positive resource company for the teacher interested in developing creative thinking skills within the classroom.

Kaplan, Sandra Nina, and Sheila Kuneshima Madsen. Think-Ins: An Approach to Relevant Curriculum, Stressing Creative Thinking and Problem Solving. Monterey Park, Ca.: Creative Teaching Press, Inc., 1974.

Application: K thru S

Thirty Think-Ins with subject areas ranging from Propoganda to Beautification are included in this book. The objective for each Think-In is: given a problem, issue, or situation, the student will be able to express and support his or her choice of a solution to it.

The Think-In format is: THE CHALLENGE or problem to stimulate thinking; HAVE YOU THOUGHT ABOUT where questions, clues, and ideas lead to data collection for problem solving; YOU COULD or a list of activities providing alternative opportunities for solving the problems with an individual learning style; IF YOU WANT TO GO FURTHER where pursuit of an independent and self-directed research project as an adjunct to the problem previously solved is encouraged.

The formats are easily followed and well-planned for independent study, Learning Centers, enrichment activities, or task cards.

----------. Keys to Productive Thinking. Project REACH, Sunnyside School, 2070 County Road H, New Brighton, Minnesota 5512.

Application: K, P, I Location: T.C.

In this project report the five areas of productive thinking are defined (fluency, flexibility, originality, elaboration, and evaluation). Sample lesson plans and/or activities for each area of productive thinking are presented. Excellent source for a quick classroom idea.

Kurfman, Dana G., Editor. Developing Decision-Making Skills, 47th Yearbook. Arlington, Virginia: National Council for the Social Studies, 1977.

Application: T Location: UNI-C

In this book decision making is discussed as a primary responsibility of social studies. Making rational decisions requires thinking skills such as analysis, application, and evaluation plus the ability to obtain and interpret information from different kinds of resources. Chapter One shows how this decision-making process incorporates thinking, information gathering, group process, and social action skills. It also includes the affective characteristics necessary in decision making and examines some curricular and instructional processes. The major skills required in decision-making are treated in Chapters Two, Three, and Four. Chapter Five deals with group action skills and Chapters Six and Seven provide models for teaching decision-making skills in elementary and secondary classes. Chapter Eight discusses evaluating student attainment of decision-making skills.

Loree, M. Ray. Problem Solving Techniques of Children in Grades Four Through Nine, Cooperative Research Project No. 2608. University of Alabama, University, Alabama, 1965.

Application: T Location: UNI-L

The major problem of Loree's research is to compare the problem solving processes of children identified as successful problem solvers with those children identified as unsuccessful

problem solvers. Children from grades four through nine are the subjects and the problem solving tasks are items on a standardized achievement test with attention being given to the process through which children arrive at the answers to the test items. The differences between the problem solving processes of children in higher grades and those in lower grades is also studied. Loree discusses related research, explains the research procedures, reports analysis of the data and findings, and then presents the project's summary and conclusions. The report along with the bibliography provide interesting information for anyone involved with problem solving in education.

----------. Making It Strange. Prepared by Synetics, Inc., New York: Harper and Row, 1968.

Application: P, I, J Location: AEA-7

Making It Strange is a series of four books plus teacher's manual for creative thinking and writing. The series' purpose is to help the student express how he feels and what he thinks. This is done by making connections or comparisons: you are a pencil with an eraser for feet and a sharp pointed head, how do you feel when sharpened; compare a giraffe and a rubber band. Each book contains step-by-step well-thought out lessons that can be done independently by the student. The books are excellent motivators for creative thought and writing.

McCumsey, Janet. "But I Have Twenty-four Others!" Area Education Agency 7, Cedar Falls, Iowa 50613.

Application: K, P, I, J Location: AEA-7

In this helpful guide for teaching the gifted within the classroom, Janet McCumsey summarizes why the bright student often does not function in the classroom, what we should be teaching the gifted, and suggests classroom provisions that can be made to teach the gifted student. A gifted definition, levels of development, and application of thinking skills are presented along with suggested activities. Reference books and teaching materials for the gifted student are also listed.

McCumsey, Janet. Encounter Lessons for the Gifted and Talented. Area Education Agency 7, Cedar Falls, Iowa 50613.

Application: K, P, I Location: AEA-7

This educational guide explains the basic concept of an encounter lesson and then presents several, well-developed encounter activities. Each activity includes: the main objectives or purpose; the procedure, lesson, or activity; follow-up questions or evaluations. Each suggestion promotes divergent thinking. A bibliography of resource books and a film complete the guide.

----------. Meeting the Needs of the Gifted. Resources for the Gifted, Inc., 3421 North 44th Street, Phoenix, Arizona 85018, Spring 1981.

This catalog offers materials that have been based on years of research in the field of gifted education and have met the criteria established by a nationally recognized staff of gifted specialists. The catalog is organized according to the primary need met by each item. The catalog categories are: problem solving; experiments and investigations; content challenges; independent study; communications/stimulation; exploratory adventures. Each item has been field tested to ensure its suitability for the classroom and home plus the accuracy of appropriate ages for the gifted. The non-gifted may also benefit from the materials in their own way.

Miletich, Yvonne Petrick. Contemporary Story Problems. The Teacher Center, Nellie Garvey School, 2201 E. Mitchell Avenue, Waterloo, Iowa 50702.

Application: I, J Location: T.C.

Ninety story problems plus an answer sheet are provided in this booklet. The student may work individually or in small groups to solve the problems which contain computational figures and information applicable to the late 1970's. Five student guidance steps stressing thinking are included.

Modlin, Ruth. Activities Using a Restaurant Theme. The Teacher Center, Nellie Garvey School, 2201 E. Mitchell Avenue, Waterloo, Iowa 50702.

Application: I, J Location: T.C.

The activities included in this booklet are planned for students to work on independently. They may be used by small groups as an enrichment activity or by the entire group as meets the classroom needs. Creative thinking and decision making are stressed utilizing language arts, math, and art skills. The 44 activities are best used in sequence. Weekly sharing times are stressed. Activity sheets, worksheets, student contracts, and teacher guides for evaluation are included.

Noller, Ruth B., Donald J. Treffinger, and Elwood D. Houseman. It's a Gas to be Gifted. Buffalo, New York: DOK Publishers, Inc., 1979.

Application: P, I, J, S Location: AEA-7

This book presents procedures for planning and conducting a program using the creative problem-solving process through a simulation called the Froop Oil Co. Simulation. The main purpose is to illustrate the application of the creative problem solving process in education by teachers and administrators. The process can also be helpful to educators and parents of gifted and talented students. The process can be learned and applied by persons with special abilities and talents in any academic, social, or artistic areas.

An overview of the Froop Oil Co. and components of the program are presented in an easily followed format. The authors recommend each student have a copy of Scratching the Surface of Creative Problem Solving to eliminate duplicating materials. The authors caution that this book is intended to introduce participants to C.P.S. but is not an in-depth study of the process.

Noller, Ruth B. Scratching the Surface of Creative Problem-Solving: A Bird's Eye-View of C.P.S. Buffalo, New York: D.O.K. Publishers, Inc., 1977.

Application: I, J, S Location: AEA-7

This book is an attempt to define and explain in a relatively short answer the Creative Problem-Solving (C.P.S.) Process. The author includes definitions of creative problem solving and process, states how C.P.S. differs from other kinds of problem solving, explains how C.P.S. helps us, and suggests its use with a variety of problems. Each phase of the process is presented in an orderly, detailed, step-by-step sequence that is easily understood and followed. An illustrative example further clarifies the process. Noller's book can be useful to anyone interested in a basic approach to C.P.S. - educators, parents, students, managers.

Parnes, Sidney J., and Harold F. Harding, Editors. A Source Book for Creative Thinking. New York: Charles Scribner's Sons, 1962.

Application: T Location: UNI-C

The purpose of this book is to provide good guides and suggestions for those who want to know more about how we think creatively and where to find more information. Included are twenty-nine articles and addresses plus over seventy-five research summaries dealing with critical thinking and creative problem solving. The book may be used as a reference source, a supplementary textbook, or as a means for further reading and research.

Raths, Louis E., Arthur Jones, Arnold Rothstein, Selma Wassermann. Teaching For Thinking. Columbus, Ohio: Charles E. Merrill, 1967.

Application: T Location: UNI-C

This book was written primarily for classroom teachers and for those preparing to teach. It treats thinking in association with the whole man - not restricted to the cognitive domain alone.

The book is concerned with theory and its applications in an area that focuses upon thinking. The emphasis is upon opportunities to think so that inquiry may go forward and decisions and conclusions be more soundly based. The authors state they are not suggesting that teachers can or should teach children how to think but should provide opportunities to think and opportunities to share thinking. The emphasis is upon teaching for thinking and how to go about it. Part I deals with exposition of a theory of teaching, Part II with application of the theory to elementary education and Part III to secondary education, Part IV with the role of the teacher in the application of the theory, and Part V is a recapitulation of the theory, research, case studies, and final comments.

Shallcross, Doris J. Teaching Creative Behavior. Englewood Cliffs, N.J.: Prentice Hall, Inc., 1981.

Application: T

This book will aid teachers and laymen in searching deeply within themselves for personal meaning. It will also enable readers to explore their understanding of the nature of creativity and its application to daily living.

This book emphasizes creativity as a constructive force. It helps the individual experience the creative process through engaging exercises and the processing of material. The author defines processing as the application of cognitive thought to the feelings that were shared in the activity. She also emphasizes the creative climate - a place where the teacher must set the creative pattern in which creativity can flow. This book demonstrates step by step how to evoke creative behavior.

The book proceeds through creativity and what it is, the creative classroom climate, presenting creativity to the individual and groups, barriers to creative thinking and overcoming these, techniques for increasing ideational power, the problem-solving process, developing sensitivity, and concludes with incorporating the creative process into the curriculum and resources for the teacher and student.

Strategies, activities, techniques, and specific practical directions for the teacher to use in evoking creative student behavior in the classroom are also included.

Sobal, Donald J. Two-Minute Mysteries. New York: Scholastic Book Services, 1967.

Application: P, I, J, S Location: AEA-7

The famous detective, Dr. Haledjian, is involved with seventy-nine mysteries, and he needs the help of a student to solve them. Tricky clues are given along with the answers. The mysteries are two-pagers and the student can scare himself as a sleuth.

Some other books by the same author include: More Two-Minute Mysteries; Encyclopedia Brown; Boy Detective; Encyclopedia Brown Finds the Clues.

Stevenson, G. M., Project Director. Igniting Creative Potential. PROJECT IMPLODE, Bella Vista Elementary School, 2131 East 7000 South, Salt Lake City, Utah, 84121, 1971.

Application: T Location: UNI-C

This booklet was produced by teachers and for professional teachers and is to be used as an ignition guide that will turn on the learner and set off productive thinking and multiple talent areas of the intellect. The materials are based on the research findings of Calvin W. Taylor, J. P. Guilford, E. P. Torrance, and Frank E. Williams. The booklet is divided into sections that deal with divergent production, convergent production, evaluation, creativity, communication, forecasting, decision making, and academic. Each section contains teaching materials and techniques for igniting the creative potential of students.

----------. Thinking Skills Remedial Through Gifted. Midwest Publications, P.O. Box 448, Pacific Grove, Ca., 93950, 1981.

Midwest Publisher's Catalog presents supplementary materials for use in developing critical thinking or problem solving skills in mathematics, reading, and language arts. The materials are

non-graded, mostly non-competitive, and range from "no read" to "medium read" levels. The games and activities can be used to individualize, or reinforce instruction or for discovery and independent work. They are not intended for daily use - purely supplemental.

Treffinger, Donald J. Encouraging Creative Learning for the Gifted and Talented: A Handbook of Methods and Techniques. Ventura, Ca.: Ventura County Superintendent of Schools, May 1980.

Application: K thru S Location: AEA-7

This book is intended as a practical resource for the imaginative teacher and provides just a "starting point." A complete description of each method and technique is not included but broad introductions are provided as suggestions for practical directions to follow.

The importance of creative learning, creative learning for all students, plus the gifted and talented is discussed. Three levels of a model for encouraging creative learning are provided with methods, techniques, and resources available for each level. The levels are: I - Divergent Functions; II - Complex Thinking and Feeling Processes; III - Real Problems and Challenges. An appendix provides a summary of major theoretical approaches to creativity. The imaginative teacher can apply the materials and techniques to all grade levels and subject areas.

Wenner, Carol, Chairperson. Make It-Take It - Math Games. Make It-Take It Committee, N.C.T.M. National Conference, San Diego, Ca., 1978.

Application: K, P, I, J, S Location: AEA-7

This book contains games selected to cover the math skills of different grade levels while emphasizing problem solving strategies and strategic thinking. The chairperson feels math abilities need to be strengthened by practice and repetition which can be done by challenging games. The games, rules, and formats are easily adaptable to the classroom's needs. Games are listed alphabetically and by topic for easy reference and the

game format is always the same. Materials for making the games are free or inexpensive. Students may invent their own games using those presented as a basis. Categories range from addition and subtraction to geometry and probability. An excellent resource for teacher and student.

Williams, Frank E. Classroom Ideas for Encouraging Thinking and Feeling.

Application: K, P, I Location: AEA-7

This book is written to assist teachers in developing the creative potential of their students. The idea lessons are designed to stimulate the processes of inquiry, discovery, and problem solving and to allow the student to do independent thinking and respond with personal feelings. Hence, cognitive thinking (fluent, flexible, original, and elaborative) and affective feeling (risk taking, complexity, curiosity, imagination) processes are encouraged.

The book is designed around a conceptual, 3 dimension model of suggested teaching strategies to attain certain pupil objectives through use of subject matter content. Dimension 1 of the model lists the areas of a conventional elementary school curriculum, Dimension 2 lists 18 strategies which teachers can use in their classroom, and Dimension 3 consists of the eight divergent production processes (4 cognitive thinking and 4 affective feeling) crucial to encouraging creative potential.

The idea lessons have been produced and classified across the three dimensions of the model by trained teachers and were field tested in the classroom. Each lesson contains the cognitive thinking and affective feeling process, the curricular area, and the strategies to be used. Some lessons include follow-up ideas.

There are three idea lesson sections to the book: K-2nd; 3rd and 4th; and 5th and 6th. The lessons can be used with all types of children - handicapped thru gifted.

Worthy, Morgan. Aha!: A Puzzle Approach to Creative Thinking. Chicago: Nelson Hall, 1975.

Application: I, J, S Location: AEA-7

A variety of word puzzles (Aha! puzzles) are presented for the development of creative or flexible thinking. The puzzles, presented in short chunks use with brief time periods, require no special knowledge or vocabulary. They are solved by insight (often called the aha! effect). A bonus of the puzzles is their ability to illustrate, stimulate, and cultivate processes of creative thought for use in everyday situations. Included are:

1. Embedded word puzzles (fitting together of different parts);
2. Flexibility puzzles (matching words and phrases having similar or related meanings);
3. Anagram Matching Puzzles (associations);
4. Lost Letters Puzzles (matching by adding or subtracting a letter or leave word as is);
5. Regroup Puzzles (form new compound words or phrases from old).

The answers are found in the back of the book. Included is a Formula-Analysis Test which measures flexible thinking.

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AEA-7 8233: Book Set. Doyle. Adventures of Sherlock Holmes.

Film: Who's on First? Iowa State Library (Schedule through your public library.)

Filmstrips: Best of Encyclopedia Brown. Waterloo FSQ-1079. Four filmstrip cassettes approximately 50 frames each. Miller-Brody, 1977. Time is allotted for students to propose own solution before Encyclopedia Brown's is revealed.

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